

# Request for Proposals for Site Contractor for the

## Haines Workforce Housing, Jones Point Road, and Medical Center Site Preparation Project

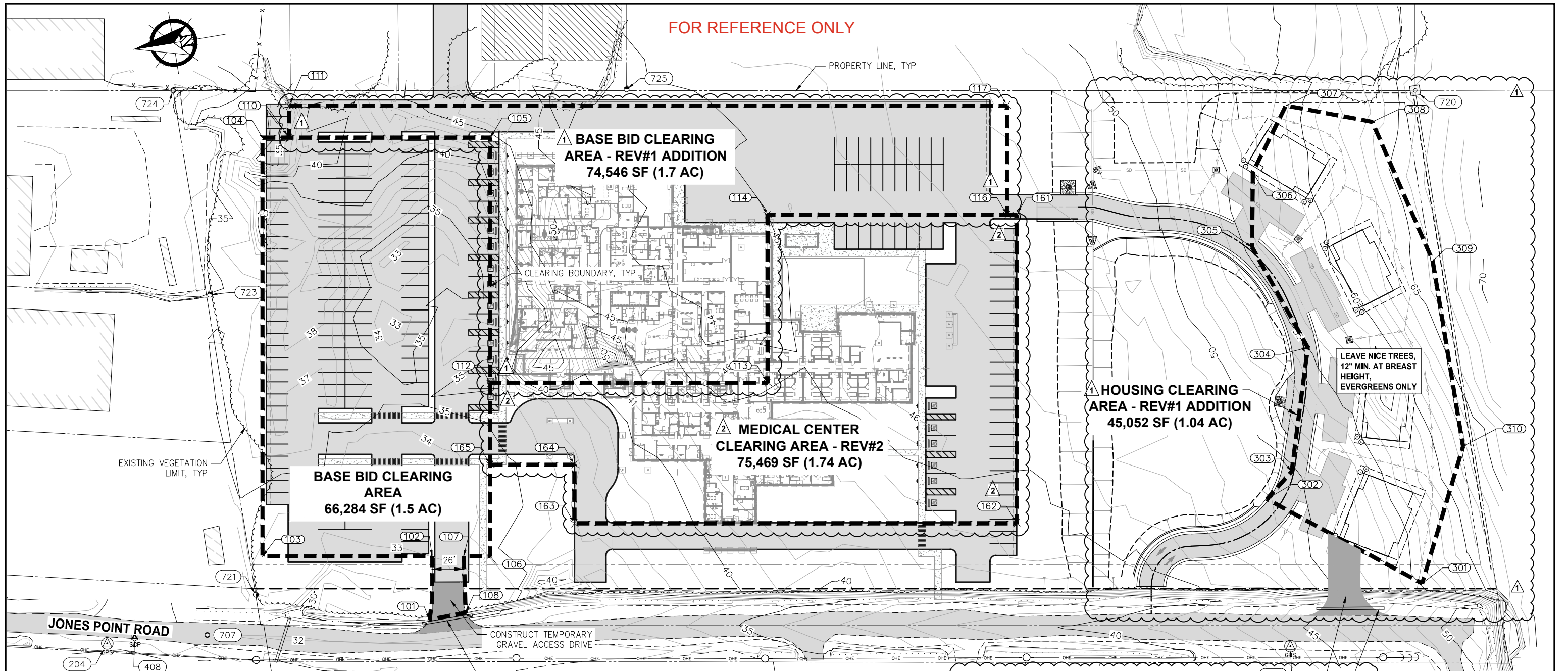
### Addendum 1

#	Question	Answer
1	Section 31200 Part 2 states that Class A Borrow "shall consist of hard angular and blasted quarry rock" meeting the specified gradations. During the Pre-Proposal Meeting, it was discussed that alternate materials may be considered acceptable for portions of the mass grading areas. Please clarify whether materials other than blasted quarry rock will be acceptable for Class A Borrow. If so, what material types and gradations will be considered acceptable? Which locations and applications are substitutions allowed?	<p>Multiple materials may be suitable depending on their depth and in what conditions the materials are placed. The following gradation criteria may be used for proposing substitute materials.:</p> <ul style="list-style-type: none"> <li>• Material placed within 4 feet of finish grade should have less than 6% passing the No. 200 sieve and a maximum particle size of 6 inches.</li> </ul> <p>Material placed deeper than 4 feet below finish grade should have a maximum particle size of 12 inches and be effectively compactible in the conditions in which it is placed (i.e. no pumping due to saturation). Effective dewatering may allow a significant sand component and not more than 10% passing the No. 200 sieve. However, if material is placed in a wet condition, a greatly reduced sand component and minimal fines will be necessary to prevent pumping during compaction.</p>
2	Please confirm the work sequencing dates on plan sheet C1.01.	In the best interest of the project work has been re-sequenced so pads for the medical facility foundation shall be ready no later than July 15, 2026. The remaining site work for the medical facility and housing will be the next priority, with the understanding the building pads for housing will be completed no later than August 15, 2026. Following the above work, Jones Point Road is the next priority. SEARHC's assumption is that the selected contractor will have the resources available to complete multiple scopes of the project simultaneously.
3	During the pre-bid meeting it was discussed that there was a prioritization of the medical center site preparation areas, please confirm what that prioritization is.	See response to #2.
4	003132 - Can a geotechnical report be made	Yes, see attached Geotechnical Report in this Addendum.

	available?	
5	RFP – 4, Please confirm whether Builders Risk Insurance is required, given that it is more commonly applicable to vertical construction.	Yes, please include Builders Risk (Course of Construction) - All Risk policy on a replacement cost basis.
6	RFP – 4, Please confirm that Excess Liability-Umbrella Form Coverage \$20,000,000.00 per occurrence, \$40,000,000.00 aggregate is required. If so, would SEARHC accept a \$20,000,000.00 Excess Liability-Umbrella policy as evidence instead?	Yes, \$20,000,000.00 Excess Liability - Umbrella policy as evidence is acceptable for this RFP.
7	RFP – 5, Please confirm that Pollution Insurance is required.	Yes, Contractors Pollution Liability will be required, \$2,000,000.00 each occurrence / \$5,000,000.00 aggregate.
8	004100, Quantities for Jones Pt Road portion, Item # 334200.1, 334200.2, and 334200.6 differ from RFP Attachment C Bid Schedule. Please confirm qtys.	See Amendment #1 for revised RFP Attachment C: Revised Unit Pricing and Contract Sum Cost Proposal Form and 004100 – Revised Cost Proposal Form.
9	015000 3.2 E, If contaminated water is encountered from the nearby DEC mapped contaminated spill site will SEARHC cover the additional cost incurred to comply with DEC requirements beyond monitoring costs?	<p>The project site is not a documented contaminated site. However, there are multiple documented contaminated sites within 1,500 feet of the project site that are listed as either Active or Cleanup Complete – Institutional Controls. The Contractor shall be responsible for securing all permits necessary for excavation and dewatering activities from ADEC based on proximity to known contaminated sites. This will include, but may not be limited to, obtaining coverage under the Excavation Dewatering General Permit and submission of an NOI and a certified BMP plan. The costs of obtaining coverage and implementing all measures identified in the certified and ADEC-approved BMP plan shall be included in the Contractor’s cost proposal.</p> <p>If contamination is encountered during construction, SEARHC will expeditiously engage a Qualified Environmental Professional to assist in developing mitigation measures for work to continue. SEARHC will request that the Contractor prepare a cost proposal to implement the mitigation measures. In the event that contamination is encountered, the Contractor shall, to the greatest extent possible, proceed to other areas of work and avoid incurring costs and expenses due to work stoppages and standby time.</p>

10	017300 3.3 B, Construction Layout - Can a PLS be used in lieu of a PE for laying out the work?	Yes
11	312000 2.3 A & B, Please verify the requirement for blasted quarry rock or if the term angular would be more appropriate for design intentions.	Angular is also a suitable term for naturally-occurring aggregate sources.
12	321216 3.4 B, Table on C2.03 pipe qtys for 334200.1 and 334200.2 do not match bid schedule. Please confirm qtys.	See Amendment #1 for revised RFP Attachment C: Unit Pricing and Contract Sum Cost Proposal Form and 004100 - Cost Proposal Form.
13	C4.07, Confirm bedding or detail for 334200.5 Stormwater Pipe, Aluminum Arch.	Minimum dimensions for bedding around all pipes shall comply with the detail shown on sheet C5.07.
14	C4.10, Detail and Spec missing for Stormwater Catch Basin, Type III Frame & Grate.	Curb inlet frames and grates shall be per Storm Drain System Table Notes, Note 3, sheet C4.07.
15	C5.05, Count 8 Ea. Sanitary Sewer Structures per Plans and Table on C5.05. Qty in bid schedule is 10 Ea. Please confirm qty.	See Amendment #1 for revised RFP Attachment C: Unit Pricing and Contract Sum Cost Proposal Form and 004100 - Cost Proposal Form.
16	Can you provide the design FG, EG, and Excavation surfaces in an XML format?	EG surfaces and an FG point file may be provided to the selected contractor after bidding, and execution of a release for the use of electronic files. An excavation surface has not been created and will not be available. Contractors are reminded that electronic information, including design points and surfaces, is being provided for convenience. The information in the sealed drawings shall govern.

FOR REFERENCE ONLY



**NOTES**

1. SEE SHEET 1 FOR SURVEY CONTROL NOTES AND TABLES.

BASE BID CLEARING LIMIT TABLE

POINT No.	NORTHING	EASTING
101	2707546.78	2348150.15
102	2707536.33	2348201.35
103	2707674.48	2348224.00
104	2707618.59	2348564.90
105	2707433.07	2348534.49
106	2707488.96	2348193.58
107	2707510.67	2348197.14
108	2707516.55	2348150.90
110	2707596.91	2348561.35

BASE BID CLEARING LIMIT TABLE

POINT No.	NORTHING	EASTING
111	2707592.62	2348587.50
112	2707465.80	2348334.85
113	2707240.12	2348297.85
114	2707217.69	2348434.66
116	2707022.60	2348402.68
117	2707008.01	2348491.66

REVISION #2 LIMIT TABLE

POINT No.	NORTHING	EASTING
161	2707014.89	2348401.41
162	2707056.07	2348150.21
163	2707416.08	2348209.24
164	2707408.26	2348256.92
165	2707476.74	2348268.14

HOUSING CLEARING LIMIT TABLE

POINT No.	NORTHING	EASTING
301	2706733.89	2348047.11
302	2706848.94	2348136.50
303	2706825.20	2348155.73
304	2706795.52	2348254.45
305	2706827.46	2348343.56
306	2706816.84	2348404.52
307	2706780.97	2348454.37
308	2706712.86	2348429.65
309	2706682.23	2348308.39
310	2706682.23	2348153.33

INSTALL 24" CPP CULVERT, MATCH PIPE INVERT TO EXISTING DITCH FLOW LINE

CONSTRUCT TEMPORARY GRAVEL ACCESS DRIVE

INSTALL 24" CPP CULVERT MATCH PIPE INVERT TO EXISTING DITCH FLOW LINE

FIELD LOCATE DRIVE AND CULVERT PER OWNER DIRECTION



REV.	DATE	DESCRIPTION	DWN.	CKD.	APP.
1	10/13/25	ADDITIONAL AND REDEFINED CLEARING AREA	WRB	SCS	SCS
2	2/10/26	ADDITIONAL AND REDEFINED CLEARING AREA	WRB	SCS	SCS



ENGINEERS, INC.

9360 Glacier Highway, Ste. 100  
Juneau, Alaska 99801  
Phone: 907-586-2093  
Fax: 907-586-2099  
www.pndengineers.com

DESIGN: MSG CHECKED: SCS SCALE: SCALE IN FEET  
DRAWN: MSG APPROVED: SCS 0 40 80 FT.

DATE: 9/10/25

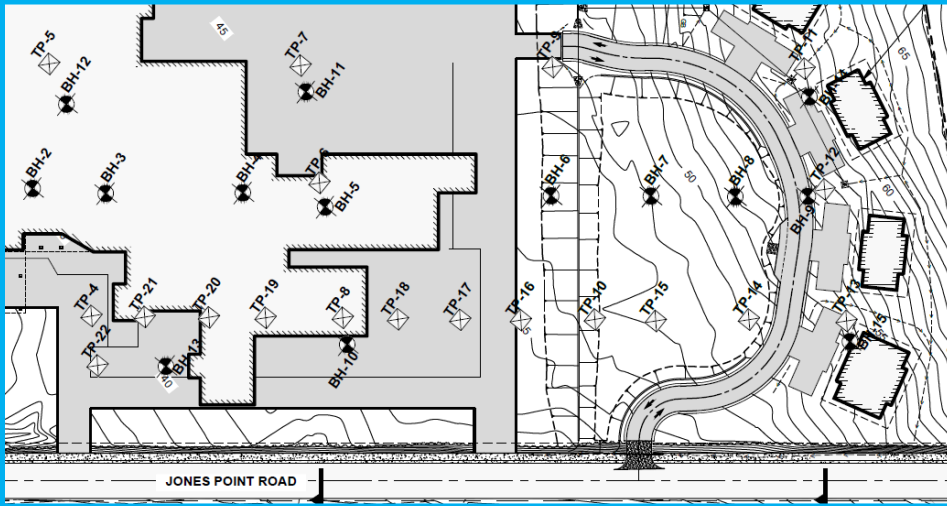
SOUTHEAST ALASKA REGIONAL HEALTH CONSORTIUM  
HAINES CLINIC SITE PREPARATION

SHEET TITLE:  
SITE CLEARING PLAN

2 OF 2

PND PROJECT NO.: 242078 C.A.N. NO.: AECC250





# Haines Medical Campus Site Investigation Geotechnical Report

December 19, 2025

Project No. 242078

PREPARED FOR:



3100 Channel Drive

Juneau, AK 99801

PREPARED BY:



ENGINEERS, INC.

9360 Glacier HWY #100

Juneau, AK 99801

## PREPARED BY

Sean Sjostedt, PE  
Kannon Lee, PE

December 19, 2023

Project No. 242078

## CLIENT REPRESENTATIVE

Mike Pountney  
Director of Facility Services  
Southeast Alaska Regional Health Consortium  
michaelp@searhc.org  
(907) 966-8413

PND Engineers, Inc. | Juneau, AK



Sean Sjostedt, PE  
Principal/Senior Engineer

A handwritten signature in blue ink, appearing to read "Kannon Lee".

Kannon Lee, PE  
Senior Geotechnical Engineer

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## 1. INTRODUCTION

This report presents the results of a geotechnical field investigation, performed by PND Engineers, Inc. (PND), in support of the proposed Southeast Alaska Regional Health Consortium (SEARHC) Haines Medical Campus in Haines, Alaska. The report has been prepared by PND and provides data gathered during the field investigation, laboratory results from testing performed on selected retained soil samples, geotechnical analyses and design recommendations, and construction considerations.

## 2. PROJECT BACKGROUND AND DESCRIPTION

### 2.1 DESCRIPTION

The proposed site (Figure 2-1) for the SEARHC Haines Medical Campus is a roughly 10-acre lot located adjacent to Jones Point Road, about 0.75 miles west of downtown Haines. The property legal description is Lot 10, Referees Subdivision. The property measures approximately 450 feet wide (east-west) and 1,025 feet long (north south). The elevation (datum unknown) ranges from a low point of 32 feet on the north end to 67 feet on the south end with areas of moderate undulation throughout and steeper grades on the southern quarter. The entire site is heavily vegetated, ranging from mature trees to thick underbrush.



Figure 2-1: Project Area

The project may also include building, utilities and roads on nearby Lots 5 and 6, Hannon Subdivision. No investigation was performed on these lots and thus the findings and recommendations contained herein may not be applicable to improvements on those lots.

## 2.2 PROJECT DESCRIPTION

The project scope, at the time this report was prepared, consists of phased construction of a medical facility including a clinic, critical access hospital, and long-term care. The clinic will be two stories while the other wings will be one story. Multi-family housing in the form of numerous one-story duplexes will also be constructed to house medical providers and non-local patients. Much of the remainder of the site will be comprised of parking and drive aisles.

## 2.3 SITE GEOLOGY

The site lies between the deltaic outlet of the Chilkat River (at the head of Chilkat Inlet) and the waters of Lynn Canal. Overburden type and thickness in Haines is highly variable even within a small area. Sand/gravel mixtures typical of river outwash deposits are often found near the surface in layers feet to tens of feet thick. Very soft marine silt and clay often underlies the surficial sand and gravel; this layer can be 50 feet thick or more but tapers to nothing and is sometimes not present at all. This soft marine silt and clay can be underlain by a hard, dry matrix-supported silty sand (diamicton) or alluvial sand/gravel mixtures of varying density. Bedrock may be 100 feet or more below the ground surface based on previous geotechnical investigations in the area.

The lot roughly 50 feet west of the project site was reportedly used as a gravel source, with excavation depths stated to be roughly 30 feet. However, nearby drilling investigations revealed soft cohesive soils up to 70 feet thick. As such, local geology can be expected to be highly variable.

## 2.4 REGIONAL SEISMICITY AND SEISMIC HAZARDS

The regional seismicity of Southeast Alaska is primarily defined by four known major faults: the Queen Charlotte-Fairweather Fault, Chatham Strait Fault, Denali Fault, and the Transition Fault. These four known faults are the main contributors to the seismic hazard of the project site. Wesson et al., (2007) found that these four faults could yield maximum moment magnitude ( $M_w$ ) earthquakes of 7.8 to 8.2 for return intervals of 2% in 50 years. These ranges are consistent with the larger historic earthquakes that have previously been documented or recorded in Southeast Alaska (Brockman et al., 1988). Earthquakes of  $M_w$  5.0 or less are common to Southeast Alaska, although they present low hazard to the project site.

The primary seismic-induced hazards for Haines and the surrounding region include strong ground shaking, slope failure, liquefaction, and landslides. Both the seismic setting and glacially-scoured, over-steepened terrain of the region contributes to the potential for both land-based and submarine landslides caused by earthquake-induced ground shaking or other triggering events, and are most likely to occur in saturated sediments and in unstable rock debris on steep slopes. Figure 2-2 shows previously recorded seismic activity in the Southeast Alaska region.

**SOUTHEAST ALASKA SEISMICITY**



Figure 2-2: Previous Seismic Activity in Southeast Alaska

**2.5 REGIONAL CLIMATE**

Haines experiences humid continental climate conditions with dry summers and wet winters. The average monthly temperatures recorded in Haines typically range from 16°F in January to 58°F in July. Daily extreme temperatures range from (-)24°F to 92°F. Average annual precipitation typically ranges from 32 to 73 inches per year. This climate data was obtained from the Western Regional Climate Center Haines station (Station 503504) for the years 1989 to 2012.

### 3. FIELD INVESTIGATION

#### 3.1 GEOTECHNICAL EXPLORATION

The geotechnical test pit investigation was performed in September 2024 with Diesel Dog Excavation providing excavation services. A total of 22 test pits were excavated across the site. The test pits were initially placed in a rough grid for broad coverage, and then supplemental test pits were added in the north area of the site to better define tapering shallow soil layers. Test pit depths ranged from 3 feet to 18 feet below ground surface (bgs). All test pits were excavated with a Hitachi 135 track-mounted backhoe.

The geotechnical drilling investigation was performed in May 2025 with Discovery Drilling, Inc. (DDI) providing drilling services. The drilling investigation consisted of boreholes with soil sampling and cone penetration tests (CPT). Three boreholes (BH-1, BH-5 and BH-9) and 12 CPTs (BH-2 through BH-4, BH-6 through BH-8, and BH-10 through BH-15) were advanced at various locations across the site. All boreholes and CPTs were advanced using a track-mounted Geoprobe 6712DT drill rig. Borehole depths ranged from 52 to 60 feet bgs. CPT depths ranged from 8.5 to 41.5 feet bgs.

PND field personnel provided oversight, directed the work, and documented findings during the investigation. Approximate borehole and test pit locations, as recorded by a handheld GPS and swing ties to existing features, are shown on the site plan presented in Appendix A.

#### 3.2 EQUIPMENT AND METHODS

##### 3.2.1 STANDARDS AND PROCEDURES

Sampling methods and classifications for soil were based on the Unified Soil Classification System (USCS) and the following American Society for Testing and Materials (ASTM) standards:

- ASTM D1586 *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*
- ASTM D2573-08 *Standard Test Method for Field Vane Shear Test in Cohesive Soil*
- ASTM D2488 *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*
- ASTM D5434 *Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock*
- ASTM D5778 *Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils*

##### 3.2.2 MODIFIED PENETRATION TESTS

Drilled boreholes were advanced using wash-rotary methods and HWT casing advancer system. Modified Penetration Tests (MPT) were performed at all drilled boreholes. Samples were typically conducted near the surface and at 2-foot intervals for the first 10 feet, then 5-foot intervals to a depth of 50 feet bgs, and 10-foot intervals thereafter to borehole termination. MPTs consist of driving a split-spoon sampler, having an outer diameter of 3 inches and inner diameter of 2.5 inches, with a 340-pound automatic drop-hammer

falling 30 inches per stroke. The number of blows required to drive the sampler for each 6-inch interval, for a maximum total distance of 24 inches, were recorded on the field borehole logs.

The blow counts shown on the borehole logs (presented in Appendix A) are field values that have not been corrected for overburden, rod length, or other factors.

### 3.2.3 VANE SHEAR TESTS

Where cohesive soils were encountered, a vane shear test was completed to determine the insitu undrained shear strength using a Geonor Vane Shear apparatus in accordance with ASTM D2573 *Standard Test Method for Field Vane Shear Test in Saturated Fine-Grained Soils*. The undrained shear strength is presented at depth on the borelogs in Appendix A

### 3.2.4 CONE PENETRATION TEST

CPTs were performed at various locations across the site to supplement the drilled boreholes and obtain additional soil data not readily collected with MPT samples. The test does not retain a physical sample of soil, but is capable of measuring tip resistance, sleeve friction, pore pressure, and other data in real time for the entire depth of the soil column. The tests were performed in accordance with ASTM D5778 *Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils* using a calibrated CPT probe with tip and sleeve areas of 10 square centimeters and 150 square centimeters, respectively. Processed data output files from each CPT location are attached in Appendix D using Geologimiki's CPET-iT software.

## 4. LABORATORY TESTING

Retained soil samples from the boreholes were transported to PND's soils-materials laboratory in Anchorage for additional testing upon completion of the field investigation. Laboratory results are presented in Appendix B. Tests performed consisted of the following:

- ASTM D2488 *Description and Identification of Soils – Visual Manual Procedure*
- ASTM D2216 *Moisture Content of Soils*
- ASTM D6913 *Gradation of Soils*
- ASTM D4318 *Atterberg Limits*

## 5. INVESTIGATION RESULTS

### 5.1 SOIL LITHOLOGY AND COMPOSITION

The results from the borehole drilling showed the subsurface conditions at the site were variable, mainly in regard to the presence and thickness of a very soft fine-grained soil deposit. A thin vegetative mat blankets essentially the entire site and overlays a roughly 2- to 5-foot-thick layer of poorly graded sand with gravel with boulders and cobbles throughout. This near-surface granular deposit overlays either gray wet clayey silt to lean clay up to about 30 feet thick, or poorly graded sand with gravel and subordinate amounts of silt of indefinite thickness that extended to borehole termination. The soft cohesive deposit

was completely absent at the north end of the project area, tapering to its greatest thickness at the southern end of the site.

The investigation included test pits excavations that further exposed and mapped the interbedded nature of the soils below the building site. Notable was an approximate 2 ft thick lens of cohesionless, coarse gravel and sand at a uniform depth of approximately 8 feet bgs. The coarse soils below this lens were observed to be intermittently interbedded with lenses of cohesive silt down to approximately 30 feet bgs. During the excavations, the cohesive material held up in the pit walls while the cohesionless material would slough.

The layer of very soft to soft clayey silt to lean clay is thickest on the southern portion of the lot at the proposed location of the housing units. The borehole and test pits advanced at the northern extent of the lot at the proposed parking lot indicated layers of medium dense to very dense sandy silty gravel to gravelly silty sand.

## 5.2 GROUNDWATER

Groundwater conditions were variable across the site and noticeably different across the two seasons that the investigations were performed. Subsurface groundwater was typically observed immediately above the silty clay/clayey silt at depths in the 3 to 5 feet bgs range. However, no groundwater was observed at several locations. Isolated locations of standing water may be present seasonally at different parts of the site.

## 6. DATA REDUCTION

### 6.1 CORRECTED BLOW COUNTS

The MPT blow counts were corrected to  $(N_1)_{60}$  using standard correlations found in most geotechnical text and are presented for the medical facility and housing location in Figure 6-1 and Figure 6-2 respectively. Boreholes BH-1 and BH-5 were used to develop design recommendations for the medical components of the project and BH-9 was applied to housing elements. Additionally, CPT data correlations to determine  $(N_1)_{60}$  blow counts are plotted representing the average CPT profiles at each respective site.

At the medical facility, design soil profile corrected blow counts highlight BH-5, which is located within the building footprint and reflects the recommended maximum excavated depth to remove the very soft clay and loose sandy clayey silt. Subsequent sections describe the range to which excavation shall occur within the building footprint to address the aforementioned clayey layers.

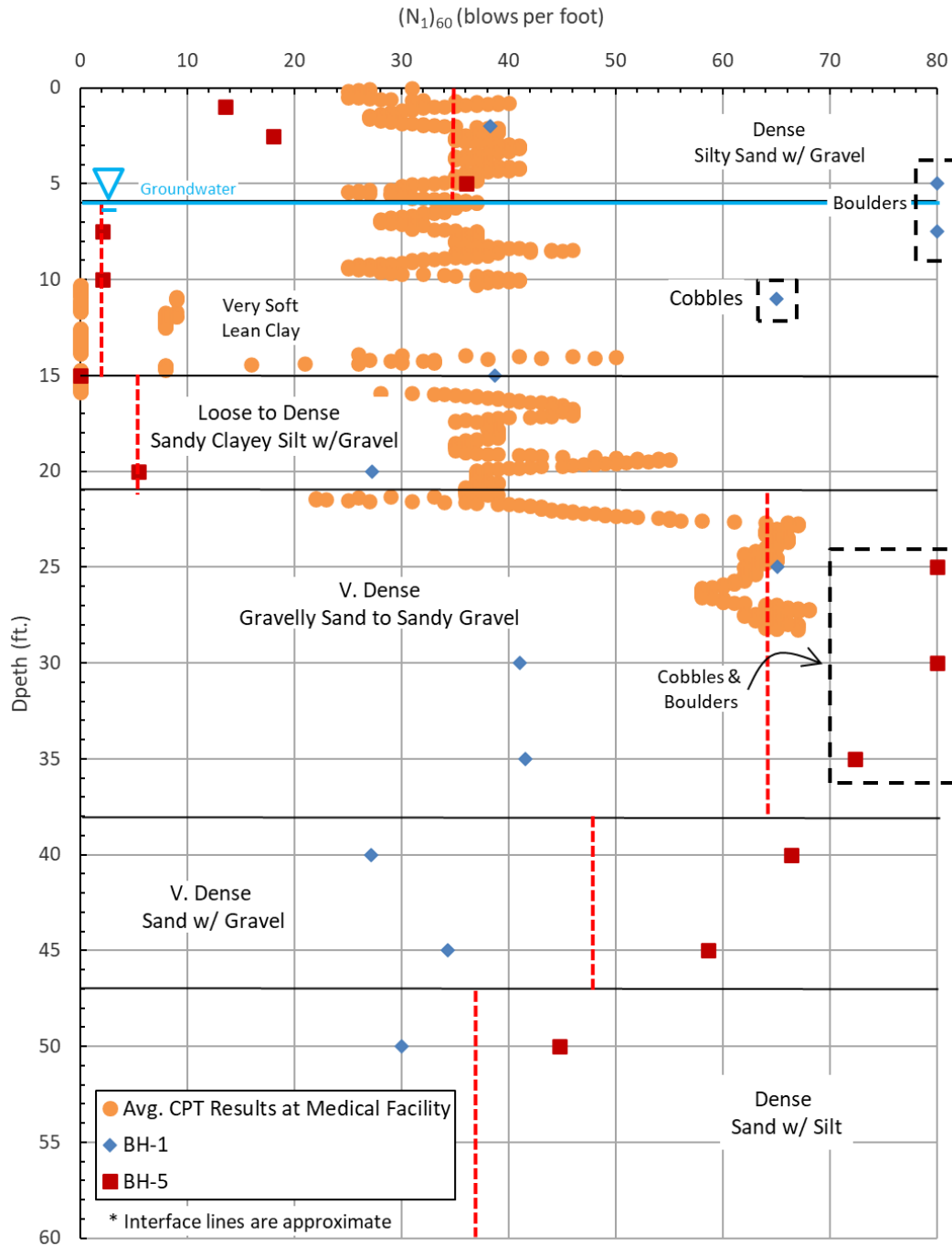


Figure 6-1. Corrected MPT Blow Counts  $(N_1)_{60}$  vs Depth (feet bgs) at BH-1 and BH-5 with the average CPT  $(N_1)_{60}$  estimated parameter across seven CPT boreholes (BH-2, -3, -4, -10, -11, -12, -13). Design corrected blow counts use BH-5 primarily to define the maximum extent of required excavation.

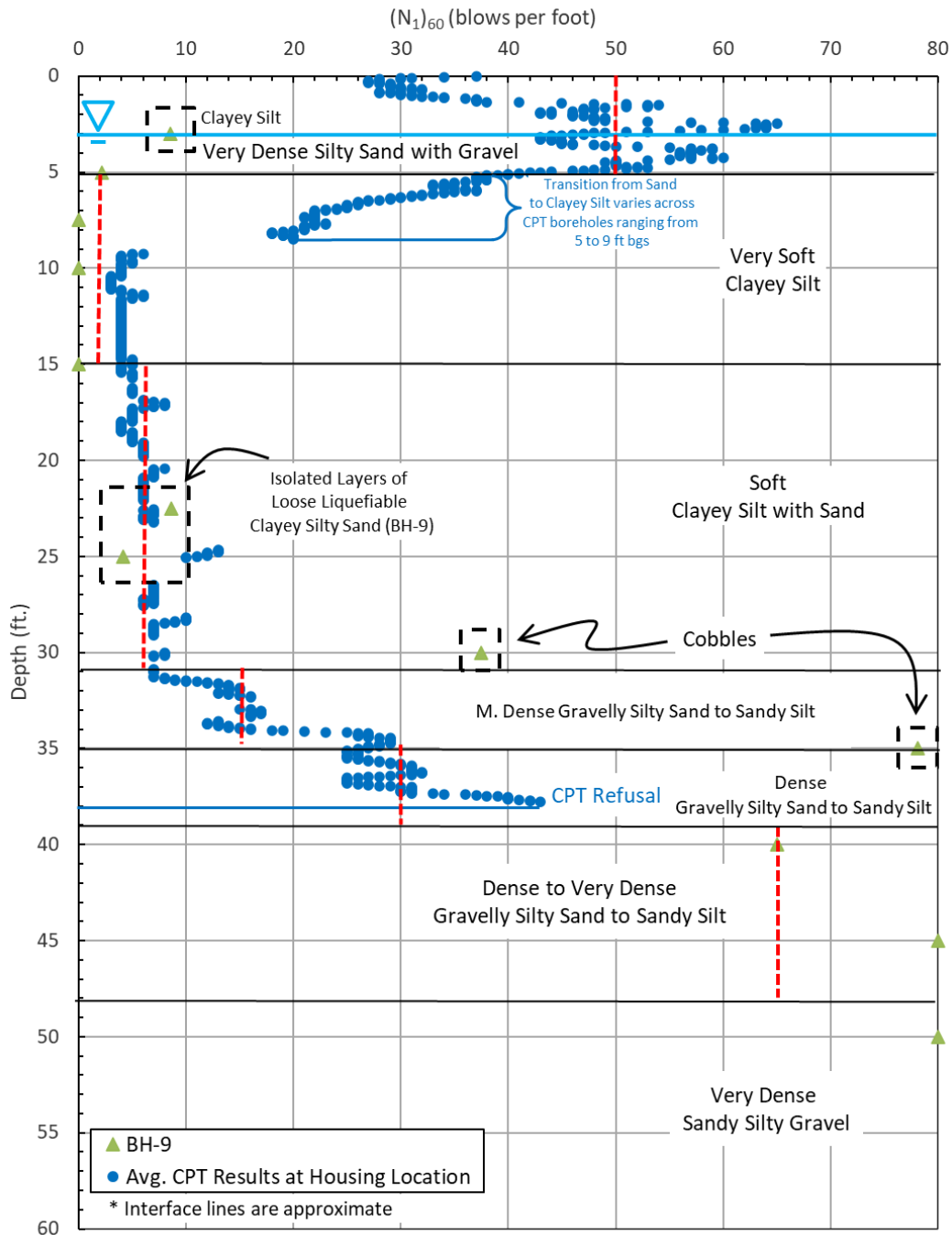


Figure 6-2. Corrected MPT Blow Counts  $(N_1)_{60}$  vs Depth (feet bgs) at BH-9 with the average CPT  $(N_1)_{60}$  estimate parameter across five CPT boreholes (BH-6, -7, -8, -14, -15).

## 6.2 CPT DATA

PND used software provided by Geologismiki’s CPeT-IT and CLiq processing databases to analyze the 13 CPT soundings. The data obtained from the CPT soundings were grouped by location to provide average estimated  $(N_1)_{60}$  values and are presented against the MPT corrected data. CPT soundings BH-2, -3, -4, -10, -11, -12, and -13 provide data supporting the medical facility design while CPT soundings BH-6, -7, -8, -14 and -15 provide data to support the housing development design. Appendix D provides the output report for all estimated soil parameters based on the CPT investigation.

## 6.3 DESIGN SOIL PROFILES

The design soil profiles are presented with average estimated cut and fill depths based on the location.

### 6.3.1 MEDICAL FACILITY

The medical facility will require complete excavation of fine-grained compressible and potentially liquefiable soils, and replacement with structural fill. The maximum total excavation below the medical facility footprint will be approximately 22 feet bgs at the southern extents, tapering to approximately 5 feet bgs at the northern extents. The resulting design soil profile at the medical facility is presented in Table 6-1 reflecting the maximum recommended excavation and structural rock backfill.

Table 6-1. Design Soil Profile Properties at the Medical Facility showing depths following Cut, Excavation, and Maximum Backfill

Soil Layer	Depth (ft bgs)		Unit Weight (pcf)	Friction Angle (°)	Est. $(N_1)_{60}$
	Fr.	To			
Structural Rock Backfill	0	22	138	38	-
Gravelly Sand to Sandy Gravel	22	38	135	40	64
Sand with Gravel	38	47	135	38	48
Sand with Silt	34	38	130	36	37

### 6.3.2 HOUSING

The housing location will require a combination of cutting into the existing sloped ground on the uphill (south) side and filling over the sloped ground on the downhill (north) side to achieve desirable grades. An additional cut of at least 5 feet below structures is recommended to distribute structural loads and decrease long-term settlement. The resulting design soil profile at the housing location is presented in Table 6-2.

Table 6-2. Design Soil Profile Properties at the Housing Location showing depths following Cut, Excavation, and Backfill

Soil Layer	Depth (ft bgs)		Unit Weight (pcf)	Friction Angle (°)	Est. $(N_1)_{60}$	Undrained Shear Strength (psf)	Settlement			
	Fr.	To					Cc	Cr	$e_0$	OCR
Structural Rock Backfill	0	5	138	38	-	-	-	-	-	-
Clayey Silt	5	10	85	25*	1	400 <sup>†</sup>	0.11	0.017	0.545	4
Clayey Silt with Interbedded Sand	10	26	95	25*	5	400 <sup>†</sup>				
Gravelly Sand with Silt	26	30	115	32	15	-	-	-	-	-
Gravelly Sand with Silt	30	34	125	35	30	-	-	-	-	-
Gravelly Silty Sand to Sandy Silt	34	43	135	38	65	-	-	-	-	-
Sandy Silty Gravel	43	46.5	135	38	65	-	-	-	-	-
*Long term drained conditions only <sup>†</sup> Short term undrained conditions only										

## 7. SEISMIC RECOMMENDATIONS

### 7.1 SEISMIC DESIGN

Seismic design at the site shall follow all applicable federal, state, and local codes. The information presented in Table 7-1 is applicable for the project based on subsurface conditions encountered and our understanding of the facility program. Moment magnitude was taken as the mode of magnitude experienced at the site, incorporating uncertainty. The seismic criteria have been delineated into two categories (medical and housing) for two reasons. First, the medical components are assumed to be Risk Category IV which typically results in larger seismic design parameters than other risk categories. Secondly, the soil conditions below the medical facility and housing will be substantially different assuming that all fine-grained soil below the medical facility is removed and replaced in accordance with the recommendations contained in this report. This results in a different site class designation that the housing will receive if the fine-grained soil remains in place below the housing.

Moment magnitude was obtained from the online USGS Seismic Hazard Toolbox disaggregation utility. All other parameters were obtained from the online ASCE Seismic Hazard Tool, with ASCE 7-22 set as the reference document.

Table 7-1. Seismic Design Parameters

Project Area	Medical	Housing
Return Period	2475 years (2% in 50 years)	2475 years (2% in 50 years)
Site Class	D*	E
Risk Category	IV	II
Seismic Design Category	D	
Moment Magnitude ( $M_w$ )	6.1	5.1
Site Adjusted Peak Ground Acceleration ( $PGA_M$ )	0.62g	0.56
$S_s$ (0.2 sec period acceleration)	1.21g	1.21g
$S_1$ (1.0 sec period acceleration)	0.52g	0.52g
$S_{DS}$ (Spect. Res. Acceleration at 0.2 sec)	1.00g	1.06g
$S_{D1}$ (Spect. Res. Acceleration at 1.0 sec)	0.91	1.62g
* Assuming excavation and replacement of compressible and liquefiable soils with structural rock fill		

## 7.2 LIQUEFACTION

A liquefaction analysis was completed to estimate the potential for in-situ soils to liquify during a maximum considered earthquake event. The program module CLiq was used to analyze all 13 CPT soundings with the results presented for each location based on the average outputs of the grouped CPT results. Earthquake-induced liquefaction generally occurs only under particular conditions, including a high groundwater table, strong earthquake ground shaking with long duration, and loose uniform sands. The analysis utilized the seismic design parameters presented in Table 7-1. The analysis at the medical facility location indicated a potential for liquefaction to occur from 5.5 feet bgs to approximately 22 feet bgs of the in-situ subsurface conditions. PND recommends excavation and back fill to between approximately 5 and 22 feet bgs to address the liquefaction concern.

At the housing location, based on in-situ subsurface conditions, potentially liquefiable soils range from a surficial sand layer overlying the clayey silt of approximately 2 feet thick followed by weak interbedded sand lenses from approximately 16 feet to 30 feet bgs. Substantial potentially liquefiable layers follow thereafter to 38 feet bgs. Figure 7-1 and Figure 7-2 present the calculated factor of safety against liquefaction vs. depth bgs for the average CPT results.



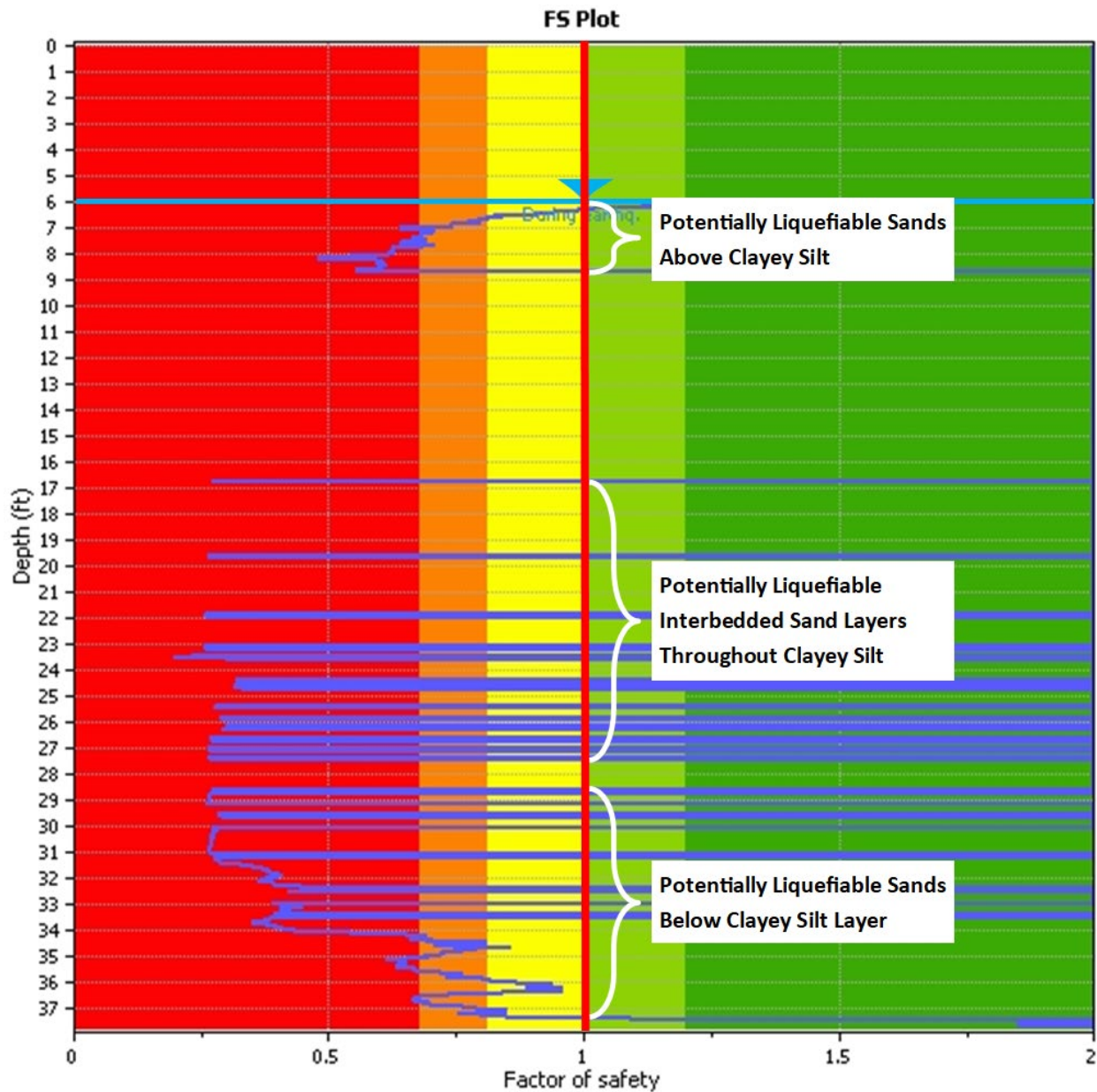


Figure 7-2. Factor of Safety Against Liquefaction vs. Depth at the Housing Location Based on the Average CPT Derived Soil Profile using CLiq.

### 7.3 SETTLEMENT DUE TO LIQUEFACTION

Table 7-2 provides an estimation of settlement due to liquefaction based on CPT results at the medical facility location and housing site. The cumulative settlement is dependent on the end depth of the sounding and will vary depending on if the data obtained was able to capture layers identified as potentially liquefiable. At the medical facility location, PND recommends approximately 22 feet excavation to bottom of potentially liquefiable soils to eliminate the potential for settlement during an earthquake event and replace with structural rock backfill.

At the housing location, total and differential settlement could be a concern over a large section of a slab-on-grade foundation. Liquefaction-induced settlement was estimated based on methods presented by Idriss and Boulanger using CLiq. To estimate possible differential settlement, Figure 7-3 provides the settlement gradient which may be multiplied by any length (i.e. building wall, distance between footings, etc.) to calculate differential settlement between two points.

Table 7-2. Cumulative Settlement Due to Liquefaction based on CPT Results

CPT Sounding Location	Cumulative Settlement due to Liquefaction (in)
Medical Facility	
BH-02	0.1
BH-03	0.6
BH-03b	1.3
BH-04	1.1
BH-06	1.0
BH-10	0.1
BH-11	4.4
BH-12	0.0
BH-13	2.9
Housing	
BH-06	1.0
BH-07	6.4
BH-08	2.5
BH-14	4.3
BH-15	3.6

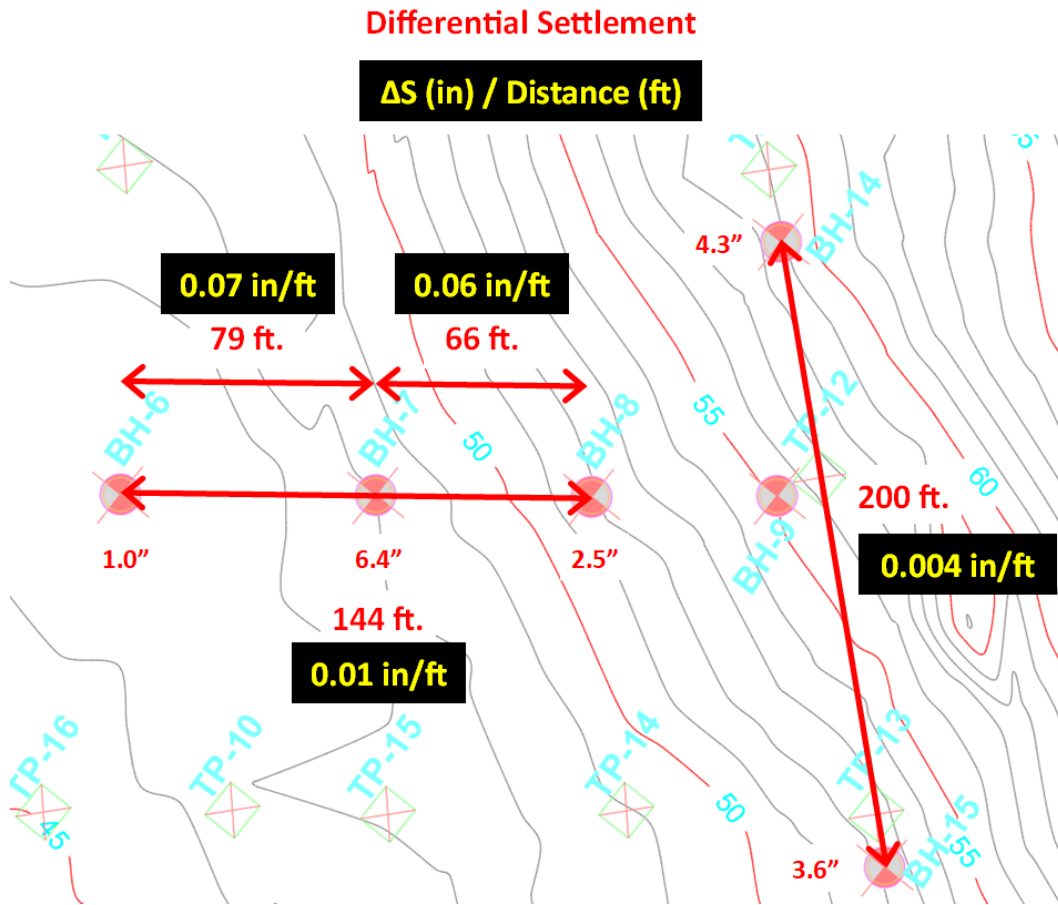


Figure 7-3. Liquefaction settlement estimations below the housing site with differential settlement gradient presented.

## 8. FROST DEPTH

PND estimated the frost depth at the site using the Modified Berggren Equation with 30-year climate normal (1991-2020) data obtained from NOAA’s National Centers for Environmental Information. The frost penetration analysis is applied to the design soil profiles following excavation and backfill and assumes that the gravel surface will be relatively clear of snow throughout the winter with an average gravel backfill moisture content of 3 percent. From the Modified Berggren analysis, the estimated frost depth is approximately 5.2 feet below finished ground surface. The extent of frost penetration can be limited with the addition of landscaping ground cover or insulation installed below grade near the building. PND recommends a design frost depth of 4 feet below grade in line with coastal locations similar to Haines, Alaska.

## 9. MEDICAL FACILITY FOUNDATION RECOMMENDATIONS

In general, foundation designs should be consistent with the current edition of the International Building Code (IBC) and with any local amendments or requirements for footing depths. Based on PND's assessment with cut and fill recommendations, the site conditions will be suitable to support the medical facility using conventional shallow foundations such as strip and column foots, mats, and structural or non-structural slabs. Cold perimeter footings shall be frost-protected or buried a minimum of 48 inches. The cover over warm or interior footings may be less. All foundations shall bear on non-frost susceptible structural fill.

The project site will be located on a maximum of 22 feet of structural rock fill. Excavation within the building footprint will range from approximately 5 feet bgs on the north end to 22 feet bgs on the south end. The building site shall be excavated to depths required to accommodate a 48-inch footing embedment and an 18-inch structural fill bearing layer beneath the footing, as well as any additional excavation required to mitigate liquefaction and long-term settlement. The in-situ groundwater depth is nominally 6 feet bgs but may increase in depth following excavation and replacement of cohesive soils.

### 9.1 MAXIMUM ALLOWABLE BEARING PRESSURE

If footing preparations follow PND recommendations, the allowable bearing pressure for medical facility foundations can be estimated from Figure 9-1 and Figure 9-2 for different footing widths pertaining to a square or continuous footing, respectively. The plots consider an elastic settlement limit of 0.5 inches. Foundation designers should consider the lower of the two intersecting curves when establishing allowable bearing pressure. Expected settlements will depend on footing dimensions and loads applied to the structure. The allowable bearing capacity includes a factor of safety of 3.0 with groundwater 2 feet below the bottom of footing (~6 feet bgs).

The allowable bearing capacity curve may be increased by 33% when considering short term loading, such as seismic loads. No such increase is permitted if the bearing pressure is controlled by elastic settlement. Further, the permissible increased bearing capacity may not exceed the equivalent bearing pressure controlled by elastic settlement for a given footing width.

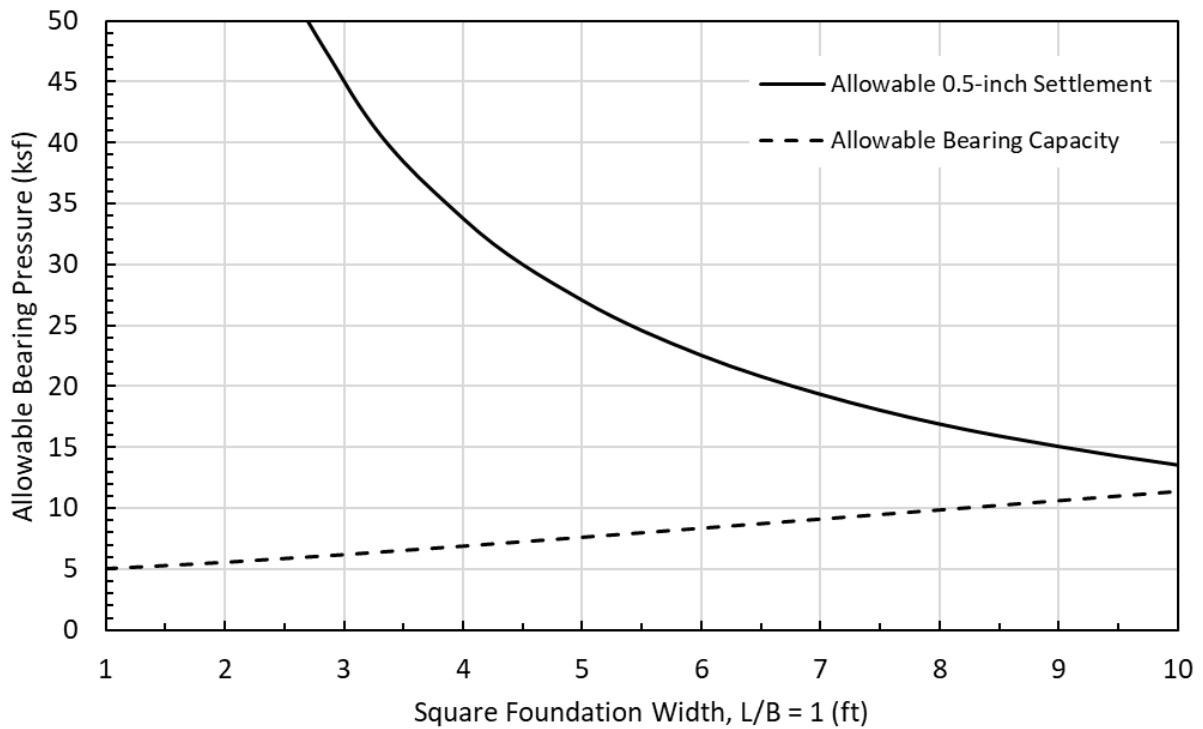


Figure 9-1. Allowable Bearing Pressure for Square Interior Spread Footings at the Medical Facility

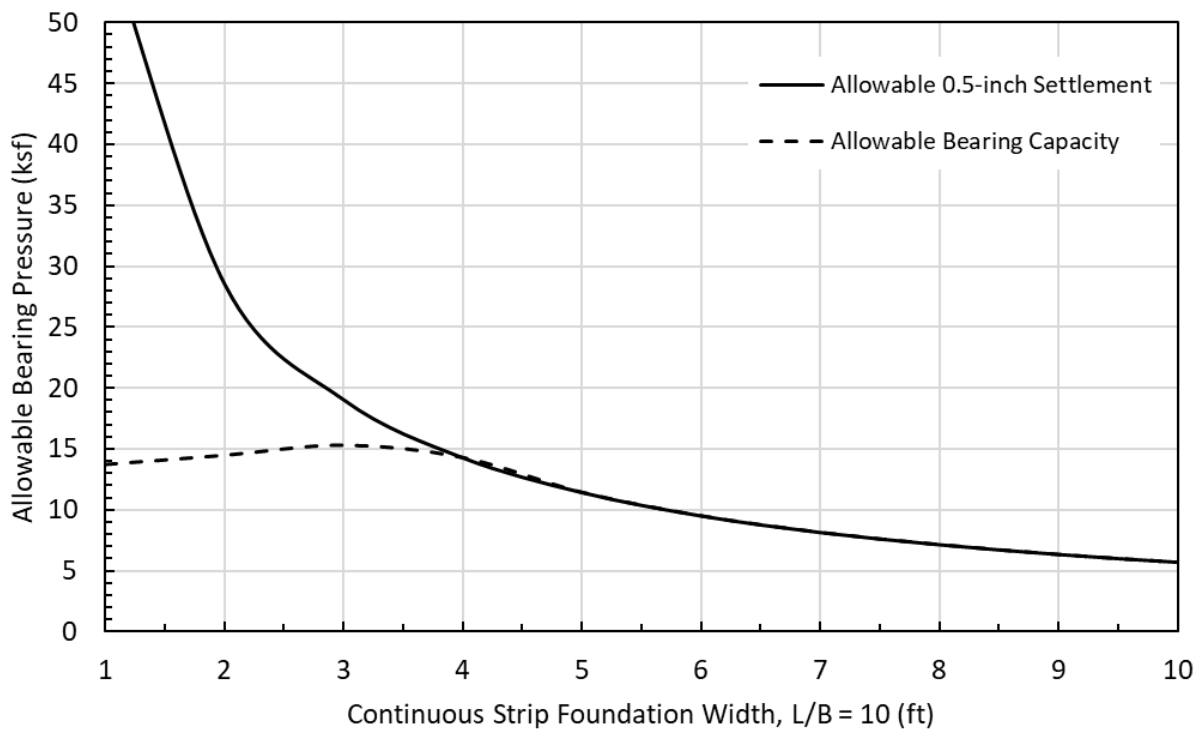


Figure 9-2. Allowable Bearing Pressure for Continuous Perimeter Strip Footings at the Medical Facility

## 9.2 DEPTH OF EMBEDMENT

- o Perimeter Footings: 48 inches, min.
- o Isolated, Interior Spread Footing: 12 inches

Perimeter footings are assumed to be warm footings. Depth is measured from the adjacent grade to the bottom of the footing.

## 9.3 ALLOWABLE ELASTIC SETTLEMENT

- o Total Settlement: 0.5 inch

Settlement from normally occurring static, live, and transient loads.

# 10. HOUSING FOUNDATION RECOMMENDATIONS

Ground improvement through removal and replacement of problematic soil is not expected to be economical for housing facilities due to the depth of required replacement. This section provides two foundation alternatives to help mitigation both long-term settlement due to primary consolidation, and liquefaction-induced settlement. The options consist of foundations supported by helical piers to bridge the problematic soils, and a mat/raft foundation to more evenly distribute load concentrations and reduce focused pressures.

Mat foundations are appropriate where a cut slope is located (generally south of the access road) and helical piles are recommended north of the access road in a fill condition where settlement and global stability is a concern. In fill condition PND expects displacements ranging between inches to a foot.

## 10.1 HELICAL PILES

Helical piles would be installed so that they bear on the dense gravelly sand with silt layer below potentially liquefiable and compressible soil layers. Helical piles primarily develop axial capacity from the helical flights bearing on soil, rather than from skin friction. Allowable capacities for helical piles with helices ranging from 8- to 12-inches in diameter are presented in Table 10-1. These capacities incorporate a factor of safety of 2 and assume that the piles will be installed to 35 feet bgs. The minimum spacing presented in Table 10-1 should be maintained to avoid pile group effects, which result in lower pile capacity. Note that these capacities are based on the bearing capacity of the soil and the area of the helix. The structural strength of the helical piles was not taken into consideration for this analysis.

Table 10-1. Maximum Helical Pile Axial Capacities

Helix Diameter (inches)	Maximum Allowable Axial Load (kips)	Minimum Spacing Between Piles (ft)
8	40.0	3
10	62.6	3.5
12	90.3	4

PND followed the “Individual Bearing Method” outlined in Chapter 4 of *Helical Piles – A Practical Guide to Design and Installation* by Perco, 2009, to provide preliminary helical pile design recommendations. A lateral load analysis should be completed once lateral loads have been provided using Ensoft’s LPile software to determine depth to fixity (minimum embed). The LPile analysis assumes that the lateral load acts on the pile head at the ground surface. To address lateral loading, PND recommends above-ground stabilization consisting of bracing if the pile head extends 2 feet or more above the finished ground surface. If the pile shaft only extends between 6 and 8 inches above grade, then wood posts and bracing/flush beam construction shall be followed to address lateral stability. Additionally, bracing battered helical piles could be utilized to capture lateral loading.

## 10.2 SLAB ON GRADE FOR HOUSING UNITS

### 10.2.1 ELASTIC SETTLEMENT AND PRIMARY CONSOLIDATION

PND completed a settlement analysis using Rocscience’s Settle3 software to determine initial elastic settlement and primary consolidation due to added overall stress from a slab-on-grade foundation to the clayey silt layer at the housing location. Soil properties were obtained from triaxial laboratory data obtained from a nearby location and compared with values provided by the CPT data analysis. The clayey silt soil properties are provided in Section 6.3.2. An evenly-distributed load of 500 psf was applied to the design soil profile to facilitate calculations.

Results indicated that settlement south of the access road are expected to be negligible, while settlement north of the access road could reach up to 0.59 inches. Elastic settlement is expected and ranges on the order of inches of settlement. Minor grade adjustments will be required after fill placement following initial elastic settlement of the clay material.

### 10.2.2 PREDICTED LIQUEFACTION-INDUCED SETTLEMENT

- o Differential Settlement: Gradient range (0.004 to 0.07 vertical in./LF)

### 10.2.3 FROST PROTECTED SHALLOW FOUNDATION

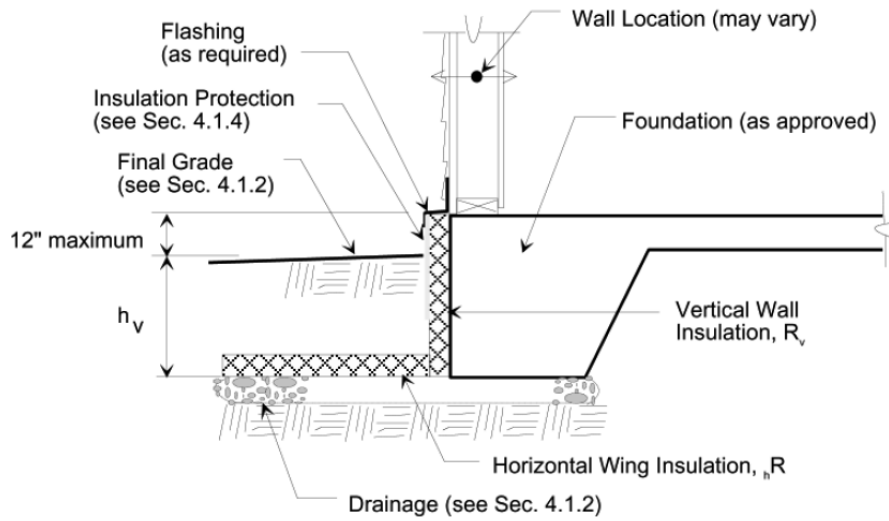
Per ASCE 32-01, the housing units could be supported by a slab-on-grade frost protected shallow foundation (FPSF) with insulation and a thickened edge to decrease footing depth. The thickened edge shall be embedded 16 inches below finished grade with insulation placed vertically and horizontally around the entire foundation. PND recommends Type IV XPS insulation as it exhibits moisture resistance over a longer period to maintain R-Value. The insulation above and below grade should be waterproofed to address surface water runoff due to storm events and landscaping. Horizontal wing insulation shall be sloped away from the foundation to aid in drainage. A shielding shall be installed where XPS is exposed above finished grade to protect from UV damage. The corner insulation is extended a distance  $D_{hc}$  at a length from the corner,  $L_c$ , in this case  $D_{hc} = 30$  inches and  $D_h = 12$  inches resulting in an additional 18-inch length at the corners. In accordance with ASCE 32-01 (2025), Table 10-2 provides the FPSF recommendations for insulation thickness and Table 10-3 provides the FPSF recommendations for lengths and widths where the insulation is placed. Reference Figure 10-1 for insulation placement detail and horizontal plan.

Table 10-2. FPSF recommendations for insulation thickness

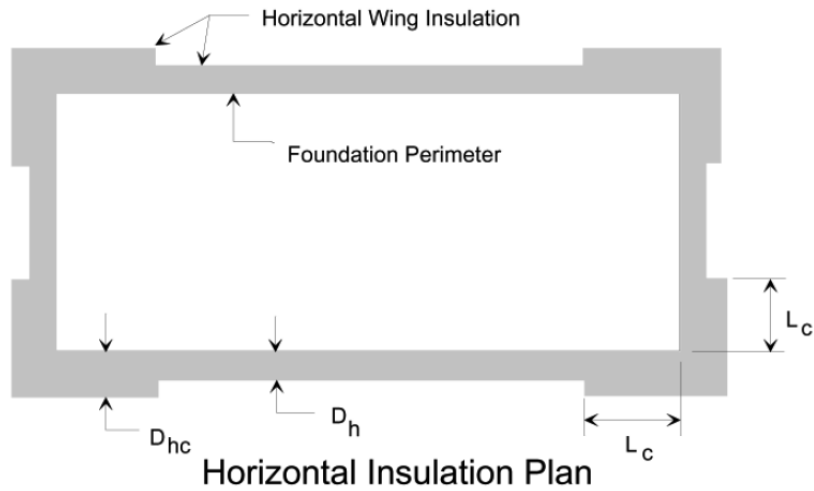
100 Year Return Freezing Index per Figure A1a of ASCE 32-01	3000 °F-Days
Vertical Insulation R-Value (hr-ft <sup>2</sup> -°F/BTU)	9.7
Horizontal Insulation R-Value (hr-ft <sup>2</sup> -°F/BTU)	6.5
Horizontal Insulation R-Value at Corners (hr-ft <sup>2</sup> -°F/BTU)	8.0
Minimum Footing Depth Below Finished Grade (inch)	16
Recommended Insulation Type	XPS Type IV
Required Vertical Insulation Thickness (inch)	3
Required Horizontal Insulation Thickness (inch)	2
Required Horizontal Insulation Thickness at Corners (inch)	2

Table 10-3. FPSF recommendations for lengths and widths for insulation placement

Height above finished grade, h (inch)	12
Foundation depth along thickened edge, h <sub>v</sub> (inch)	16
Vertical Insulation length, h+h <sub>v</sub> (inch)	28
Width of horizontal wing insulation along walls, D <sub>h</sub> (inch)	12
Width of horizontal wing insulation at corners, D <sub>hc</sub> (inch)	30
Length along a wall of corner insulation, L <sub>c</sub> (inch)	40



Insulation Detail



Horizontal Insulation Plan

Figure 10-1. Slab-on-grade foundation for heated buildings

### 10.3 GLOBAL STABILITY AT HOUSING LOCATION

The housing site is moderately sloped at present, but the slopes will be steepened to facilitate a bench cut for the proposed structures. The cut will extend south into the slope and backfilled with structural rock fill that will extend north over the toe of the existing slope. The analysis considered 40' x 40' slab on grade structures applying a 500 psf load on the backfill.

A slope stability analysis of the cut and fill slope was performed using Rocscience’s Slide2 to assess global stability under static and seismic conditions. The horizontal seismic load was reduced by half for the analysis, assuming that some movement (on the order of inches) is permissible. The drained and

undrained clay properties were also analyzed to observe long term and short-term slope stability. The resulting cut into the slope will remove the surficial dense silty sand layer and extend a maximum of 2 feet into the clayey silt layer ranging from 5 to 7 feet thick fill layers. The results of the slope stability analysis are provided in Table 10-4 with targets for static and seismic Factors of Safety being 1.5 and 1.1, respectively. There is moderate concern for the short-term conditions where the FS targets are not met.

Due to the factors of safety under seismic conditions being less than 1.0, Newmark displacement calculations were performed according to the method described in Bray and Travasarou (2007). The analysis indicated potential high displacements in magnitude that would render the structure unusable, but will not cause collapse or life and safety concerns.

Slope stability figures are provided in Appendix C.

Table 10-4. Slope Stability Factors of Safety at the Housing Location

Clay Conditions	Static	Seismic
Undrained (short term)	1.2	0.6
Drained (long term)	2.4	1.1

## 11. GENERAL FOUNDATION RECOMMENDATIONS

### 11.1 LATERAL LOAD RESISTANCE

Lateral loads on footings and retaining walls will be resisted by passive earth pressures developed against the footing block and frictional resistance against the base of the footing. Recommended lateral earth pressure coefficients are summarized in Table 11-1 for the Medical Facility and Housing locations, assuming structural fill with a friction angle of 38° and an interface friction angle of 25°. The active and passive pressure values assume level backfill and vertical wall.

Table 11-1. Static and Seismic Lateral Earth Pressures

Lateral Earth Pressure	Medical Facility		Housing	
	Static	Seismic	Static	Seismic
At-rest, $K_0$	0.384	-	0.384	-
Active, $K_{a/AE}$	0.238	0.453	0.238	0.421
Passive, $K_p$	4.200	-	4.200	-

## 11.2 MODULUS OF SUBGRADE REACTION

Calculation of the modulus of subgrade reaction is a function of both the soil and the structural element. The recommended value for  $k_1$  (subgrade reaction modulus for foundations measuring 1-foot by 1-foot) at the project site is 1000 pci. Das (2014) provides a series of equations utilizing  $k_1$  that may then be used to calculate an appropriate subgrade reaction modulus for various foundation geometries.

## 11.3 FOUNDATION UPLIFT

Uplift loads may manifest in some foundation elements due to overturning moments that occur as a result of wind and seismic forces. Uplift loads may be resisted by the weight of the structure and soil above foundation footings, as well as shear resistance within the soil matrix.

The following equation may be utilized to determine the allowable uplift resistance of shallow rectangular footings in cases where subbase or base course make up the entirety of the soil above the footing. For square footings, the footing width,  $B$  is taken equal to the footing length,  $L$ .

$$Q_u = 105.8D^2(7.1B + L - B) + W$$

where:

- $Q_u$  = ultimate footing uplift resistance
- $B$  = footing width
- $L$  = footing length
- $D_f$  = footing burial depth
- $W$  = Base weight (weight of concrete and soil uplifted)

A factor of safety of 3 should be applied to  $Q_u$  to obtain an allowable value, which may be increased by 33% when considering short-term transient loads such as wind and seismic forces.

## 12. DRIVEWAYS AND ACCESS ROADS

A significant area of the project contains highly frost-susceptible soil at fairly shallow depths. At these locations, the minimum road structural section should consist of:

- 3 inches of hot-mix asphalt concrete pavement
- 4 inches of base course
- 42 inches (minimum) of subbase

The subbase should be separated from the fine-grained subgrade by a robust geotextile suited for both separation and stabilization. This minimum section is necessary to avoid seasonal frost heave in the winter and thaw weakening in the spring. The north parking area appears to be capable of supporting a less-robust typical section due to the presence of clean sands and gravels within the frost penetration zone. The subbase layer thickness may be reduced to 12 inches in this case, and no geotextile is required.

## 13. CONSTRUCTION CONSIDERATIONS

### 13.1 SITE RECOMMENDATIONS

All earthworks should be performed according to the project specifications and in accordance with local, state, and federal laws and regulations and standards of practice.

### 13.2 SITE PREPARATION

Organic material at the surface should be removed and wasted offsite. The site climbs in elevation from north to south and will likely require a combination of cutting some areas and filling others to achieve a single finished grade desired for the medical facility.

### 13.3 EXCAVATIONS

Temporary excavations into soil should be performed with care and follow OSHA or other agency guidelines and recommendations for trenching and slope angles based on soil type encountered in the geotechnical investigations and as observed during construction. Permanent excavations into soil should either be retained or sloped to meet long term stability requirements. Care shall be taken with the deep excavations at the medical facility location to remove the clay and potentially liquefiable soils.

Any frozen soil must be removed from subgrades beneath the footings and slabs and replaced with material as recommended in this report and following all project specifications.

### 13.4 DRAINAGE AND CONTROL OF WATER

The average groundwater table is approximately 5 to 7 feet below ground surface at both the medical facility location and housing site. The level below ground surface is likely controlled by the cohesive lean clay or clayey silt layer. Excavations will likely experience significant infiltration from both shallow groundwater and runoff from elevation areas. A robust dewatering effort should be anticipated. The lean clay to clayey silt could be very difficult to work with when wet and disturbed. The weather should be monitored during excavation and construction when in-situ lean clay and clayey silt material is exposed. It is the contractor's responsibility to determine the appropriate dewatering technique(s) for the construction method chosen and for the soil and water conditions encountered in the geotechnical explorations and during construction.

Because the site is sloped in areas, grading will need to be designed to effectively move water away from construction activities. Site grading should be established to provide drainage of surface water away from the proposed building and toward suitable drainage structures. Ground adjacent to the building's foundation should be graded to slope away from the building at a minimum 1%, or steeper as code considerations permit.

### 13.5 FILL AND COMPACTION

This section provides general recommendations for the use of aggregate (structural) fill to be used during construction. Generally, imported structural fill should comply with AKDOT&PF Standard Specifications, with modifications as determined necessary. All structural fill should be angular, clean, sound, durable, and free of any frozen clumps, ice, or any deleterious material prior to placement. Structural fill should follow all project specifications and be a well-graded mixture of non-frost susceptible (NFS) sand and

gravel. For the purposes of this report, structural fill can be segregated into two material sub-types: subbase and base course.

Subbase should have a maximum particle size of 6 inches with less than 6 percent passing the No. 200 sieve size. Subbase shall be placed in lifts not exceeding 12 inches in loose thickness. Compaction of subbase shall be achieved by performing a minimum level of effort consisting of six complete passes with a 15-ton vibratory steel drum roller. In areas that are too small to accommodate a roller, compaction shall be accomplished by a minimum level of effort of six complete passes with a vibratory plate compactor with a minimum rated centrifugal force of 15,000 lbs. Compaction effort should be re-evaluated if alternate equipment is used.

Base course should have a maximum particle size of 1 to 1.5 inches and less than 6% passing the No. 200 sieve size. Base course shall be placed in lifts not exceeding 8 inches in loose thickness and shall be compacted to not less than 95 percent of the maximum density as determined by ASTM D1557 maximum density method. Base course compaction in the field should be verified by nuclear densometer per ASTM D6938.

In areas where deep excavations are anticipated, a more economical material (defined herein a Select Borrow) may be used from the bottom of the excavation up to 4 feet below finished ground surface or deeper if excavations for utilities are a consideration. Select Borrow should consist of predominantly gravel, such that it will not pump or hold moisture in a saturated condition, with a maximum particle size of 18 inches and not more than 10% passing the No. 200 sieve. Select Borrow shall be placed in lifts not exceeding 24 inches in loose thickness and compacted similarly to subbase.

All fill material should be protected from freezing during construction. No frozen soil should be used as fill, nor should any fill be placed over frozen soil. Any frozen soil should be removed, replaced, or thawed prior to fill placement.

Moisture control of materials should be implemented when stockpiling and placing fill material. Stockpiles should be covered to prevent saturation during wet weather conditions. Additional moistening or drying of fill material may be required in order to obtain the optimum moisture content for maximum compaction.

## 14. LIMITATIONS AND CLOSURE

The information submitted in this report is based on our interpretation of data from a field geotechnical investigation conducted for this project, laboratory test results, and other sources discussed in this report. Effort was made to obtain information that is representative of the actual conditions at the site. However, actual subsurface conditions will vary and additional information may be discovered that could impact our recommendations. If conditions significantly different from those indicated in this report are encountered by subsequent investigations or during construction, the recommendations of this report should be reviewed by PND.

This report was prepared by PND Engineers, Inc., for use on this project only, and may not be used in any manner that would constitute a detriment to PND. PND is not responsible for conclusions, opinions, or recommendations made by others based on data presented in this report.

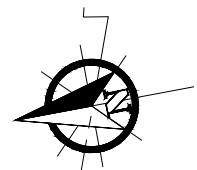
Included in Appendix E is a copy of the Geoprofessional Business Association (GBA) publication “Important Information about Your Geotechnical-Engineering Report.” The publication is included in this report to help the Owner, Contractor, and others who read this document understand the limitations described above and the additional limitations contained in the publication and made a part of this report. This document should be read carefully. If in the opinion of Contractors bidding this project, sufficient information has not been made available to satisfactorily bid the project then the Contractor should perform additional geotechnical investigations as necessary to satisfy themselves as to site conditions.

## 15. REFERENCES

- ASTM D1586. “Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.”
- ASTM D2216 “Moisture Content of Soils”
- ASTM D2487. “Classification of Soils for Engineering Purposes (Unified Soil Classification System).”
- ASTM D2488. “Description and Identification of Soils (Visual Manual Method).”
- ASTM D2573 “Standard Test Method for Field Vane Shear Test in Cohesive Soil”
- ASTM D4318 “Atterberg Limits”
- ASTM D5434. “Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock.”
- ASTM D5778 “Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils”
- ASTM D6913 “Gradation of Soils”
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- Das, Braja M (2014). Principals of Foundation Engineering, 8<sup>th</sup> Edition. Cengage Learning. Boston, MA.
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Youd, et al, (2001). Liquefaction Resistance of Soils: "Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils", Journal of Geotechnical and Geoenvironmental Engineering.

## Appendix A. Site Survey, Test Location Map, Geologic Section, and Test Logs



LOT 8B HANNON SUBDIVISION II  
 PLAT NO. 2010-17  
 BIGFOOT AUTO SERVICE INC  
 51,389 SQ.FT  
 1.18 ACRES

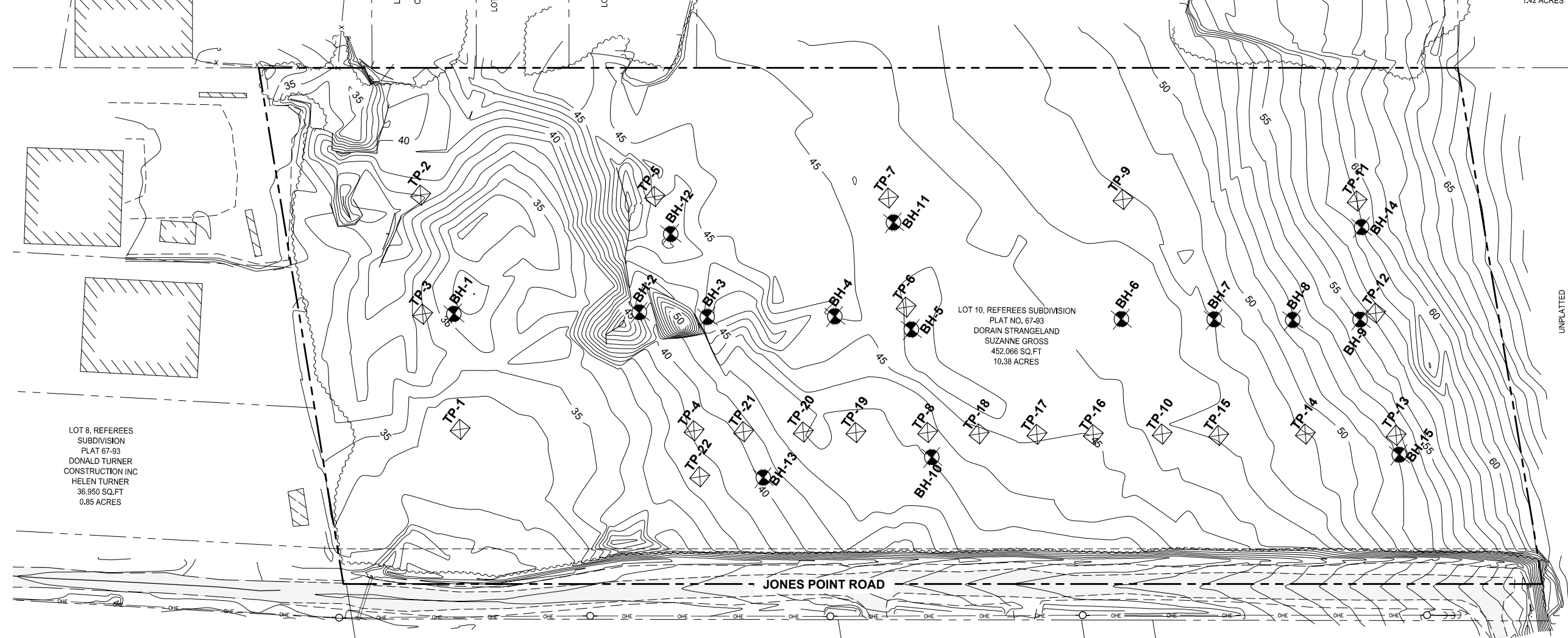
LOT 7, HANNON SUBDIVISION  
 PLAT NO. 97-13  
 CORNUCOPIA PROPERTIES &  
 INVESTMENTS LLC  
 37,978 SQ.FT  
 0.872 ACRES

LOT 6, HANNON SUBDIVISION  
 PLAT NO. 97-13  
 GARY JACOBSON  
 28,291 SQ.FT  
 0.65 ACRES

LOT 5, HANNON SUBDIVISION  
 PLAT NO. 97-13  
 BRUCE HALE  
 AMANDA ST. CLAIR  
 38,989 SQ.FT  
 0.90 ACRES

USS 735, TR 1  
 PLAT NO. 92-10  
 ALASKA POWER & TELEPHONE  
 229,858 SQ.FT  
 5.73 ACRES

LOT 4C, HANNON SUBDIVISION  
 PLAT NO. 97-13  
 MICHAEL CARTER  
 LORI WEBSTER  
 61,896 SQ.FT  
 1.42 ACRES



UNPLATTED  
 HAINES BOROUGH  
 39,716 ACRES

LOT 8, REFEREES  
 SUBDIVISION  
 PLAT 67-93  
 DONALD TURNER  
 CONSTRUCTION INC  
 HELEN TURNER  
 36,950 SQ.FT  
 0.85 ACRES

LOT 10, REFEREES SUBDIVISION  
 PLAT NO. 67-93  
 DORAIN STRANGELAND  
 SUZANNE GROSS  
 452,066 SQ.FT  
 10.38 ACRES

LOT 9, REFEREES SUBDIVISION  
 PLAT NO. 67-93  
 LINDSEY JOBBINS  
 105,851 SQ.FT  
 2.43 ACRES

LOT B, A SUBDIVISION OF A POR,  
 TRACT 11, REFEREES SUBDIVISION  
 PLAT NO. 2002-3  
 SUSAN REX  
 266,818 SQ.FT  
 6.12 ACRES

PORTION USS 785  
 DEED 1980-000199-0  
 RAYMOND STASKA  
 CONNIE STASKA  
 42,709 SQ.FT  
 0.98 ACRES

LOT A, A SUBDIVISION OF A POR, TRACT 11,  
 REFEREES SUBDIVISION  
 PLAT NO. 2002-3  
 SUSAN REX  
 188,907 SQ.FT  
 4.34 ACRES

**TEST HOLE LEGEND**

TEST PIT  
 TP-#

BOREHOLE/  
 CPT  
 BH-#

PND ENGINEERS, INC.:  
 09/24 INVESTIGATION

PND ENGINEERS, INC.:  
 THIS INVESTIGATION

**REVISIONS**

REV.	DATE	DESCRIPTION	DWN.	CKD.	APP.

**PND**  
 ENGINEERS, INC.

9360 Glacier Highway Ste 100  
 Juneau, Alaska 99801  
 Phone: 907-586-2093  
 Fax: 907-586-2099  
 www.pndengineers.com

DESIGN: SCS    CHECKED: SCS  
 DRAWN: PJD    APPROVED: SCS

SCALE: SCALE IN FEET  
 0    50    100 FT.

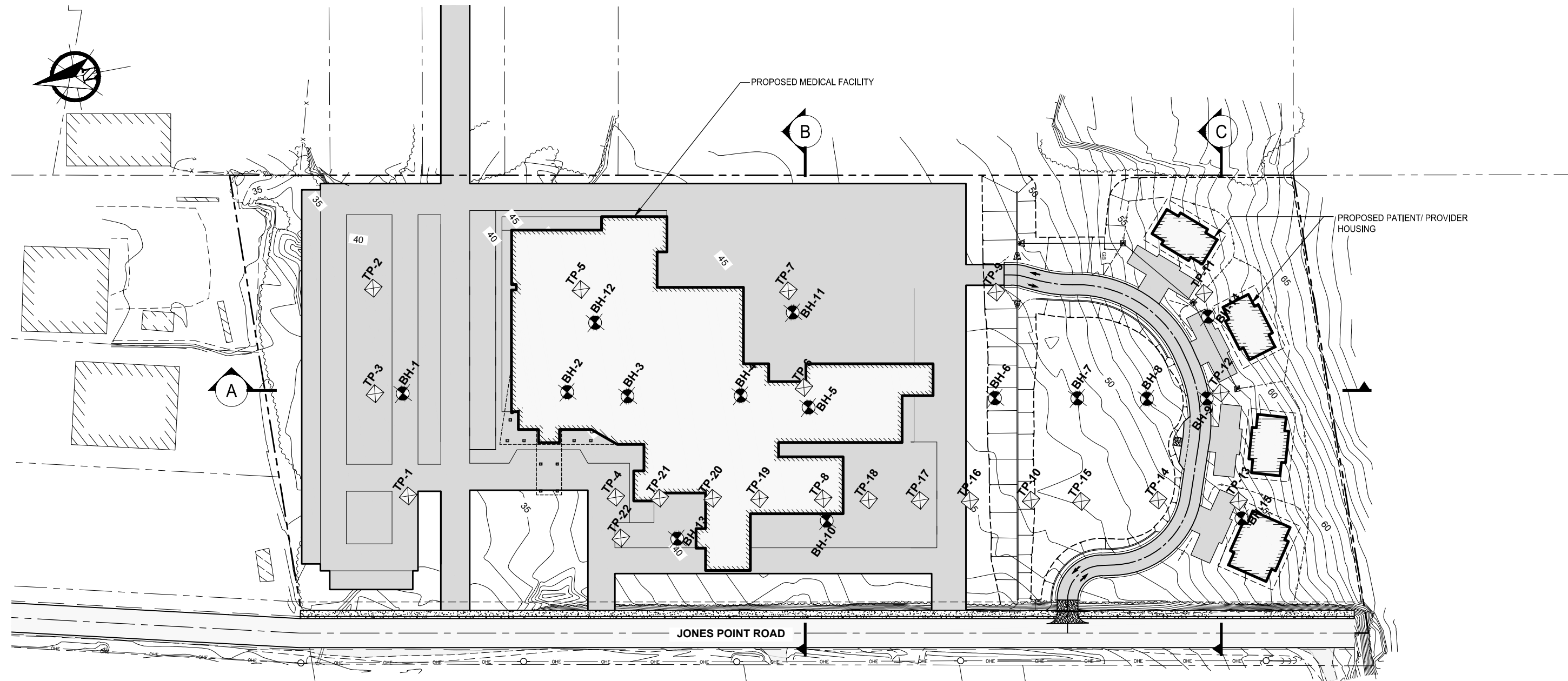
**SEARCH  
 HAINES MEDICAL CAMPUS  
 GEOTECHNICAL SITE INVESTIGATION**

SHEET TITLE: **EXISTING CONDITIONS  
 AND TEST HOLE LOCATIONS**


PND PROJECT NO.: 242078.03    C.A.N. NO.: AECC250


DATE: DEC. 2025

**A1**



**TEST HOLE LEGEND**

TEST PIT  PND ENGINEERS, INC.: 09/24 INVESTIGATION

BOREHOLE/ CPT  PND ENGINEERS, INC.: THIS INVESTIGATION

REVISIONS					
REV.	DATE	DESCRIPTION	DWN.	CKD.	APP.

**P | N | D**  
ENGINEERS, INC.

9360 Glacier Highway Ste 100  
Juneau, Alaska 99801  
Phone: 907-586-2093  
Fax: 907-586-2099  
www.pndengineers.com

DESIGN: SCS CHECKED: SCS  
DRAWN: PJD APPROVED: SCS

SCALE: SCALE IN FEET  
0 50 100 FT.

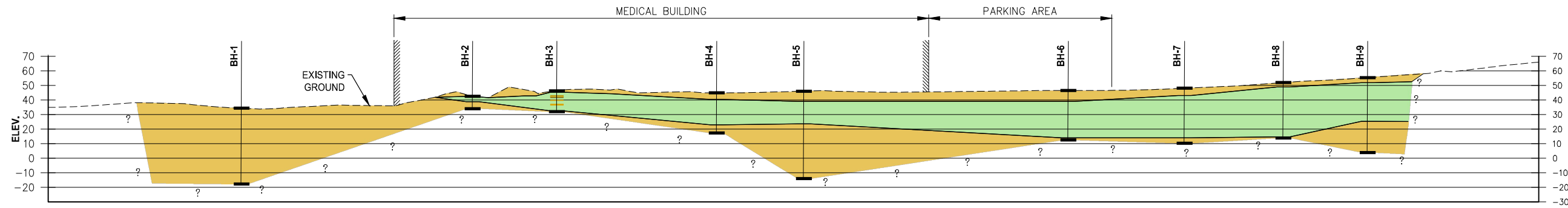
DATE: DEC. 2025

**SEARCHC  
HAINES MEDICAL CAMPUS  
GEOTECHNICAL SITE INVESTIGATION**

SHEET TITLE: **SITE PLAN  
w/ TEST HOLE LOCATIONS**

PND PROJECT NO.: 242078.03 C.A.N. NO.: AECC250

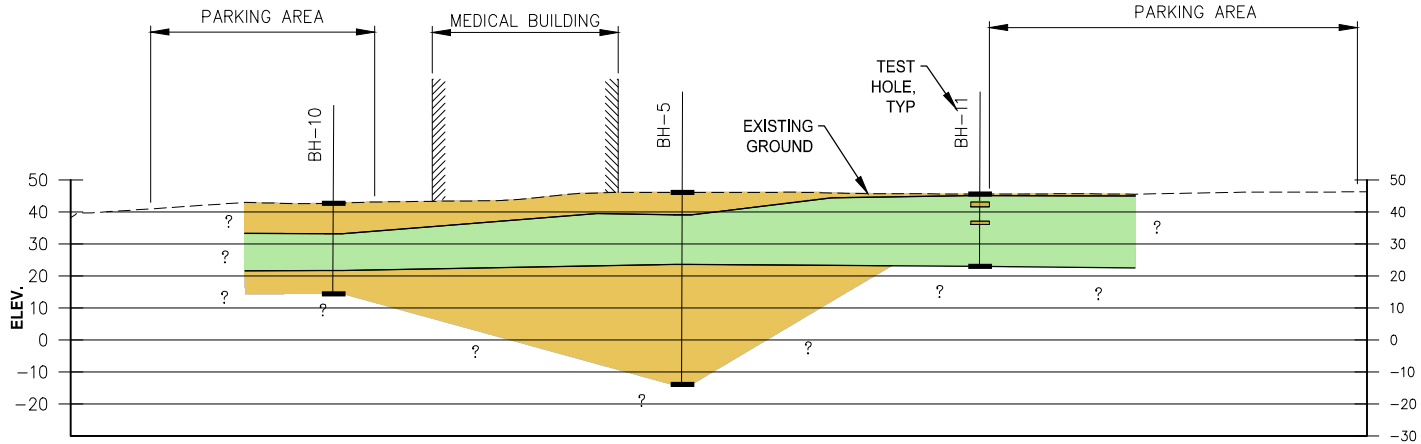
**A2**



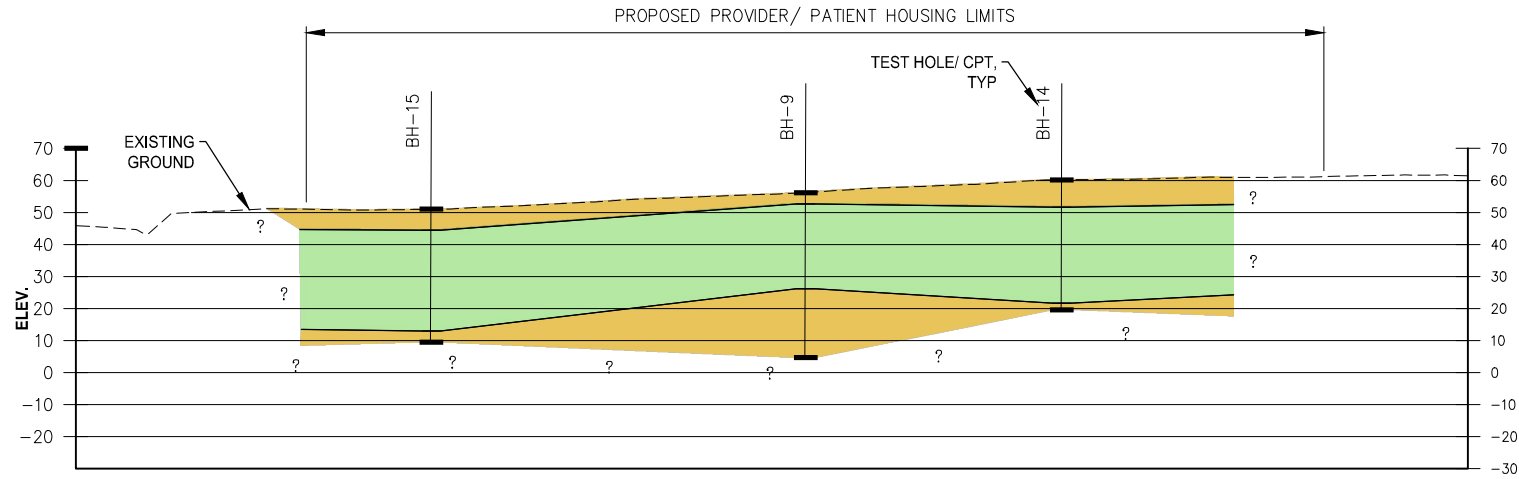
**LEGEND**

- SAND AND GRAVEL
- SILT AND CLAY

**A SITE PROFILE**  
SCALE IN FEET  
0 40 80 FT.



**B SITE SECTION**  
SCALE IN FEET  
0 30 60 FT.



**C SITE SECTION**  
SCALE IN FEET  
0 30 60 FT.

REVISIONS					
REV.	DATE	DESCRIPTION	DWN.	CKD.	APP.

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Juneau, Alaska 99801  
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Fax: 907-586-2099  
www.pndengineers.com

DESIGN: SCS CHECKED: SCS SCALE: AS SHOWN  
DRAWN: PJD APPROVED: SCS

DATE: DEC. 2025

**SEARCHC  
HAINES MEDICAL CAMPUS  
GEOTECHNICAL SITE INVESTIGATION**

SHEET TITLE:  
**SITE PROFILE AND SECTIONS**

PND PROJECT NO.: 242078.03 C.A.N. NO.: AECC250

# SOILS CLASSIFICATION, CONSISTENCY AND SYMBOLS

## CLASSIFICATION

Identification and classification of soil samples is accomplished in general accordance with the ASTM version of the Unified Soil Classification System (USCS) as presented in ASTM Standard D2487. The standard is a qualitative method of classifying soil into the following major divisions (1) coarse grained soil, (2) fine grained soil, and (3) highly organic soils. Classification is performed on a soil sample which passes the 75 mm (3 inch) sieve, oversize material (> 75 mm particles) is noted on the soil logs as well. Classification of oversize material is not always possible because the oversize particles are typically too large to be captured in the sampling equipment. Oversize materials greater than 300 mm (12 inches) are termed boulders, while materials between 75 mm and 300 mm are termed cobbles. Coarse grained soils are described as having 50% or more of the sample retained on the No. 200 sieve (0.075 mm) while fine grained soils will have 50% or more of the sample passing the No. 200 sieve. Coarse samples containing >50% material retained on the No. 4 sieve is classified as gravel. If a majority of the sample is retained on the No. 200 sieve but passes the No. 4 sieve it is classified as a sand. Fine grained soils are those having more than 50% of the sample passing the No. 200 sieve; these may be classified as silt or clay depending their Atterberg limits or observations of field consistency. Refer to the most recent version of ASTM D2487 for a complete discussion of the classification method.

## SOIL CONSISTENCY - CRITERIA

Soil consistency as defined below and determined by normal field and laboratory methods applies only to non-frozen material. For these materials, the influence of such factors as soil structure, i.e. Fissure systems, shrinkage cracks, slickensides, etc., must be taken into consideration in making any correlation with the consistency values listed below. In permafrost zones, the consistency and strength of frozen soils may vary significantly and unexplainably with ice content, thermal regime and soil type.

## STANDARD PENETRATION TEST (BLOWS/FT) RELATIVE TO DENSITY/CONSISTENCY

$N_{60}$	Density	Relative Density	$N_{60}$	Consistency
0-4	Very Loose	0-15%	< 2	Very Soft
4-10	Loose	15-35%	2 - 4	Soft
10-30	Medium Dense	35-65%	4 - 8	Medium Stiff
30-50	Dense	65-85%	8 - 15	Stiff
> 50	Very Dense	>85%	15 - 30	Very Stiff
			> 30	Hard

## UNDRAINED SHEAR STRENGTH

psf
< 250
250 - 500
500 - 1000
1000 - 2000
2000 - 4000
> 4000

(\*correlations based upon standard 1.4" O.D. split spoon and 140 lb manual hammer dropped from a height of 30 inches)

(\*Adjust as required for other sampler types)

Ref: Terzaghi and Peck, Soil Mechanics in Engineering Practice, 3rd Edition, pg 60-63  
 ASTM D1586 Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils  
 ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (USCS)

## LIST OF ABBREVIATIONS

Drill Methods:	Sample Methods:	Color:	Particle Angularity
AR Air Rotary	AR Air Rotary	G Gray	A Angular
CC60 Continuous Coring (RS-60)	Cc Continuous Core	GG Greenish Gray	R Rounded
CD Case and Drill	GR Grab Sample	LB Light Brown	SA Sub-Angular
CCm Continuous Coring (Macro Core)	Sh Oversize Split-Spoon	LG Light Gray	SR Sub-Rounded
CME Continuous Augering	Ss Standard Split-Spoon	OG Olive Gray	Particle Shape:
CWR Casing with Wash Rotary	ST Shelby Tube	P Pink	E Elongated
DH Down-hole hammer	Cs Core Sample	R Reddish	F Flat
HSA Hollow Stem Auger	Color:	RO Rusty Orange	
HWT Casing Advancer	BK Black	TN Tan	
MR Mud Rotary	BN Brown	YO Yellowish Orange	
NQ3 NQ3 Triple Tube	DG Dark Brown	BG Brownish Gray	
WR Wash Rotary	DG Dark Gray		
TP Test Pit			



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 Date: SEPT. 2024

## STANDARD BOREHOLE LOG DETAILS

BOREHOLE LOGS

FIGURE A-4

Depth (feet)	Water Table	GRAPHIC SYMBOL	SOIL/ROCK DESCRIPTION	SAMPLES					GRAPH				COMMENTS	Elevation (feet)
				Number	Type	Location	Recovery (%) (RQD)	Penetration Blows per 6/Inch (per Foot)* or {Rock Quality}	■ BLOW COUNT (BPF)* 20 40 60 80	● POCKET PEN. (TSF) 1 2 3 4	▲ VANE SHEAR (TSF) 2 4 6 8			
0.0			0' - 0.30' A.C. PAVEMENT											24.43
2			POORLY-GRADED GRAVEL W/ SILT AND SAND (GP-GM) Gray, Moist, Dense, Subangular	1	Ss		30	20-20-25 (45)		■			Begin drilling 10/24/03 8:00 a.m. 1.5' to 2' - Hard, loud drilling (Cobbles/Boulder encountered)	22.43
			SLATY ARGILLITE grayish black, fine grained, thin bedded, medium hard, BX-U, steeply dipping	2	Ct		56 (50)	{Poor}					drillhole blockage	

### COLUMN DESCRIPTIONS

- 1** Depth                      Depth (in feet) below the ground surface (bgs).
- 2** Water Level                Groundwater level recorded while drilling. Depths and times are recorded in comments column.
- 3** Graphic Log                 Graphic depiction of materials encountered.
- 4** Soil/ Rock Description      Description of materials encountered, including USCS soil descriptions and rock descriptions defined in Fig. B-5 and B-6.
- 5** Sample Number             Sample identification number.
- 6** Sample Type                Type of soil or rock sample collected at depth interval depicted; symbols explained on Fig. B-1.
- 7** Sample Location            Location of soil or rock sample taken.
- 8** Sample Recovery            Soil: Percentage of sample recovered. Rock: Percentage of sample recovered and RQD value.
- 9** Sample Blows or Rock Quality    Soil: Number of blows to advance driven sampler each 6-inch interval using sampler type specified with a 30-inch drop. Blows per foot given in parentheses. Rock: Rock quality as defined from RQD value.
- 10** Graphs                      Graphic log depicting blow counts per foot with a specified split spoon, Pocket Penetration and Vane Shear tests depicted where taken on fine grained soils.
- 11** Comments                 Comments or observations on drilling/sampling by driller or PND field personnel.
- 12** Elevation                  Elevation (in feet) with respect to Mean Lower Low Water (MLLW) or other datum where specified.

### GENERAL NOTES

- Field descriptions may have been modified to reflect laboratory test results.
- Descriptions on these boring logs apply only at the specific locations at the time the borings were drilled. They are not warranted to be representative of subsurface conditions at other locations or times.
- Split spoon blow counts shown are uncorrected raw data. Various hammer sizes and split spoon sizes were used and have not been corrected to a Standard Penetration Test (SPT). Blow counts may vary substantially between SPT and these methods.

 ENGINEERS, INC.	Designed: PND Drawn: PND Checked: PND Project No.: 242078.01 Date: SEPT. 2024	<b>STANDARD BOREHOLE LOG DETAILS</b>	
		<b>BOREHOLE LOGS</b>	<b>FIGURE A-5</b>

# Soil Legend

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS	
			GRAPH	LETTER		
COARSE GRAINED SOILS  MORE THAN 50% RETAINED ON NO. 200 SIEVE (0.075mm)	GRAVEL AND GRAVELLY SOILS  MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE (4.75mm)	CLEAN GRAVELS  (LITTLE OR NO FINES)		GW	Well-graded gravels, gravel sand mixtures, little or no fines	
		GRAVELS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	
		SAND AND SANDY SOILS  MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE (4.75mm)	CLEAN SANDS  (LITTLE OR NO FINES)		SW	Well-graded sands, gravelly sands, little or no fines
			SANDS WITH FINES  (APPRECIABLE AMOUNT OF FINES)		SP	Poorly graded sands, gravelly sands, little or no fines
	FINE GRAINED SOILS  MORE THAN 50% PASSING NO. 200 SIEVE (0.075mm)	SILTS AND CLAYS  LIQUID LIMIT LESS THAN 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		SILTS AND CLAYS  LIQUID LIMIT GREATER THAN 50		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
				CH	Inorganic clays of high plasticity, fat clays	
HIGHLY ORGANIC SOILS				OH	Organic clays of medium to high plasticity, organic silts	
				PT	Peat and other highly organic soils	

## Stratigraphic Contact

- Distinct contact between soil strata or geologic units
- Gradual change between soil strata or geologic units
- Approximate location of soil strata change within a geologic soil unit

### NOTES:

1. Coarse grain soils with fines content >5% or <15% require dual symbols: example GW-SM, SW-SM
2. Multiple symbols can be used to indicate borderline or dual soil classifications

## Laboratory / Field Tests List of Abbreviations

%F	Percent Fines	HA	Hydrometer Analysis	PM	Permiability or Hydraulic Conductivity
AL	Atterberg Limits	LL	Liquid Limit	PP	Pocket Penetrometer
CP	Laboratory Compaction test	LMA	Limited Mechanical Analysis	SA	Sieve Analysis
CO	Consolidation test	MC	Moisture Content	TV	Torvane
DP	Depth "Peat" Probe	MD	Moisture content and Dry density	TX	Triaxial Shear
DS	Direct Shear	OC	Organic Content	UC	Unconfined Compression
		PL	Plastic Limit	VS	Vane Shear



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## STANDARD BOREHOLE LOG DETAILS

BOREHOLE LOGS

FIGURE A-6

## METRIC CONVERSIONS

Length	1 inch	= 25.4 mm	1 mm	= 0.0394 inch
	1 foot	= 0.3048 m	1 m	= 3.281 feet
	1 mile	= 1.6093 km	1 km	= 0.621 mile
Area	1 sq. inch	= 6.452 cm <sup>2</sup>	1 cm <sup>2</sup>	= 0.155 sq. inch
	1 sq. foot	= 0.0929 m <sup>2</sup>	1 m <sup>2</sup>	= 10.764 sq. foot
	1 acre	= 0.4047 hectare	1 hectare	= 2.47 acre
	1 sq. mile	= 2.59 km <sup>2</sup>	1 km <sup>2</sup>	= 0.386 sq. mile
Volume	1 cu. inch	= 16.387 cm <sup>3</sup> (cc)	1 cm <sup>3</sup>	= 0.061 cu. inch
	1 cu. foot	= 0.0283 m <sup>3</sup>	1 m <sup>3</sup>	= 35.31 cu. foot
	1 cu. yard	= 0.7646 m <sup>3</sup>	1 m <sup>3</sup>	= 1.308 cu. yard
	1 U.S. gallon	= 3.785 liters	1 liter	= 0.264 U.S. gallon
Mass	1 lb.	= 0.4536 kg	1 kg	= 2.205 lb.
Force	1 lb.	= 4.448 N	1 N	= 0.225 lb.
	1 ton	= 8.896 kN	1 kN	= 0.1124 U.S. ton
Density	1 lb./cu. ft.	= 16.019 kg/m <sup>3</sup> = 0.1571 kN/m <sup>3</sup>	1 kg/m <sup>3</sup>	= 0.0624 lb./cu. foot
			1 kN/m <sup>3</sup>	= 6.365 lb./cu. foot
Pressure/Stress	1 lb./sq. in.	= 0.0703 kg/cm <sup>2</sup> (= 6.895 kPa)	1 kg/cm <sup>2</sup>	= 14.22 lb./sq. inch
			1 kPa	= 0.145 lb./sq. inch
	1 lb./sq. ft.	= 4.882 kg/cm <sup>2</sup> (= 0.04788 kPa)	1 kg/cm <sup>2</sup>	= 0.2048 lb./sq. ft.
			1 kPa	= 20.886 lb./sq. foot
	1 U.S. ton/sq. ft.	= 95.76 kPa	1 kPa	= 0.01044 U.S. ton/sq. foot
	[Note: 1 kPa	= 1 kN/m <sup>2</sup>		
Flow Velocity	1 gal./min.	= 6.309 x 10 <sup>-5</sup> m <sup>3</sup> /sec	1 m <sup>3</sup> /sec	= 15,850 gallons per minute
	1 ft./sec.	= 0.3048 m/sec	1 m/sec	= 3.28 ft./sec
Coefficient of Compressibility M <sub>v</sub> :	1 sq. ft./U.S. ton	= 0.0104 m <sup>2</sup> /kN		
	1 sq. in./lb	= 14.22 cm <sup>2</sup> /kg		
Coefficient of consolidation C <sub>v</sub> :	1 sq. ft./year	= 0.0929 m <sup>2</sup> /year (= 0.002946 mm <sup>2</sup> /sec)	1 m <sup>2</sup> /year	= 10.76 sq. ft. /year
			1 mm <sup>2</sup> /sec	= 339.4 sq. ft./year
Moment	1 lb.-ft.	= 0.1383 kq-m (= 1.3558 Nm)	1 kq-m	= 7.23 lb.-foot
			1 N-m	= 0.7376 lb.-foot
Speed	1 mile/hour	= 1.609 km/hour (= 0.447 m/sec)	1 km/hour	= 0.622 mile/hour
			1 m/sec	= 2.237 mph
	1 foot/sec	= 0.3048 m/sec	1 m/sec	= 3.281 feet/sec



ENGINEERS, INC.

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Drawn: PND

Checked: PND

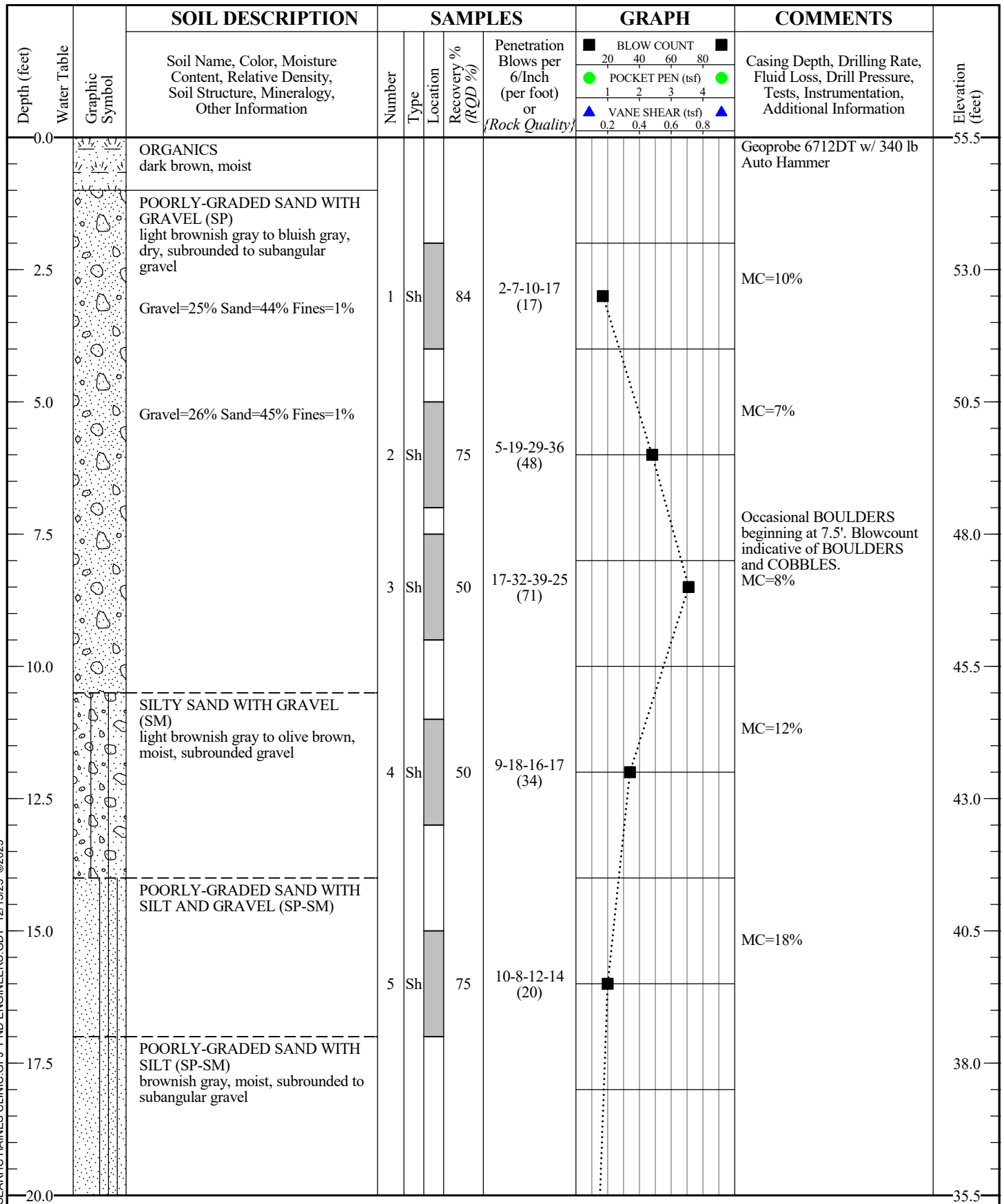
Project No.: 242078.01

Date: SEPT. 2024

## STANDARD BOREHOLE LOG DETAILS

BOREHOLE LOGS

FIGURE A-7



BOREHOLE LOG 242078.03 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025



ENGINEERS, INC.

Logged By: MEE  
 Data Entry: MEE  
 Checked: SCS  
 Project No.: 242078.03  
 Date: May. 2025

SEARHC HAINES MEDICAL CAMPUS  
 Haines, Alaska

BH-1

FIGURE A-8  
 1 of 3

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION	SAMPLES				GRAPH	COMMENTS	Elevation (feet)	
			Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80 ● POCKET PEN (tsf) ● 1 2 3 4 ▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8		Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information
20.0			POORLY-GRADED SAND WITH SILT (SP-SM) brownish gray, moist, subrounded to subangular gravel(continued) Gravel=7% Sand=88% Fines=5%	6	Sh		67	4-5-9-14 (14)	■	3" heave MC=18%	35.5
22.5											33.0
25.0				7	Sh		100	6-15-22-23 (37)	■	1' heave MC=18%	30.5
27.5			Gradational color change POORLY-GRADED SAND WITH SILT (SP-SM) bluish gray, wet, subrounded to subangular gravel								28.0
30.0				8	Sh		0	6-9-15-16 (24)	■	BOULDERS present but able to advance past.	25.5
32.5											23.0
35.0				9	Sh		67	6-13-13 (26)	■	MC=17%	20.5
37.5											18.0
40.0											15.5

BOREHOLE LOG 242078.03 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025



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 Data Entry: MEE  
 Checked: SCS  
 Project No.: 242078.03  
 Date: May. 2025

SEARHC HAINES MEDICAL CAMPUS  
Haines, Alaska

BH-1

FIGURE A-8  
2 of 3

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION	SAMPLES				GRAPH				COMMENTS	Elevation (feet)		
			Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80 ● POCKET PEN (tsf) ● 1 2 3 4 ▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8	Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information					
40.0			POORLY-GRADED SAND WITH SILT (SP-SM) bluish gray, wet, subrounded to subangular gravel( <i>continued</i> ) Gravel=5% Sand=84% Fines=11%	10	Sh	42	5-8-10-13 (18)	■					MC=20%	15.5	
42.5														13.0	
45.0					11	Sh	25	6-10-14-17 (24)	■					MC=21%	10.5
47.5														COBBLES beginning at 47'.	8.0
50.0				12	Sh	0	8-10-12-7 (22)	■					2' heave	5.5	
52.5													TOTAL DEPTH=52'	3.0	
55.0														0.5	
57.5														-2.0	
60.0														-4.5	

BOREHOLE LOG 242078.03 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025



Logged By: MEE  
 Data Entry: MEE  
 Checked: SCS  
 Project No.: 242078.03  
 Date: May. 2025

**SEARHC HAINES MEDICAL CAMPUS**  
**Haines, Alaska**

**BH-1**

**FIGURE A-8**  
**3 of 3**

BOREHOLE LOG 242078.03 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION	SAMPLES				GRAPH				COMMENTS	Elevation (feet)	
			Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot)* or (Rock Quality)	<div style="display: flex; justify-content: space-around;"> <span>■ BLOW COUNT</span> </div> <div style="display: flex; justify-content: space-around; font-size: small;"> <span>20</span> <span>40</span> <span>60</span> <span>80</span> </div> <div style="display: flex; justify-content: space-around;"> <span>● POCKET PEN (tsf)</span> </div> <div style="display: flex; justify-content: space-around; font-size: small;"> <span>1</span> <span>2</span> <span>3</span> <span>4</span> </div> <div style="display: flex; justify-content: space-around;"> <span>▲ VANE SHEAR (tsf)</span> </div> <div style="display: flex; justify-content: space-around; font-size: small;"> <span>0.2</span> <span>0.4</span> <span>0.6</span> <span>0.8</span> </div>	Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information				
0.0			ORGANICS brown, moist										Geoprobe 6712DT w/ 340 lb Auto Hammer MC=16%	46.0
2.5			WELL-GRADED SAND WITH GRAVEL (G(SW)) brownish orange, moist, subrounded gravel; organic clots, roots Gravel=47% Sand=48% Fines=5%	1	Sh		100	1-2-4-5 (6)					MC=14%	43.5
5.0			POORLY-GRADED SANDY GRAVEL WITH SILT (S(GP-GM)) gray, wet, subrounded to subangular gravel	2	Sh		75	3-3-5-19 (8)					MC=10%	41.0
7.5			SANDY LEAN CLAY (S(CL)) bluish gray, wet, subrounded to subangular gravel	3	Sh		75	11-7-9-5 (16)					COBBLES present throughout	38.5
10.0			SANDY LEAN CLAY (S(CL)) bluish gray, wet, subrounded to subangular gravel	4	Sh		0	1-1-0-0 (1)*					*Spoon sank 18" on second blow.	36.0
12.5			SANDY LEAN CLAY (S(CL)) bluish gray, wet, subrounded to subangular gravel	5	Sh		0	1-0-1-0 (1)					MC=31%; LL=30 PL=21	33.5
15.0			CLAYEY SILT WITH SAND (S(CL-ML)) bluish gray, wet, subrounded to subangular gravel; fine sand Gravel=7% Sand=39% Fines=54%	6	Sh		100	1-0-0-0 (0)					VS = 0.47tsf MC=22%; LL=23 PL=18	31.0
17.5														28.5
20.0														26.0



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**SEARHC HAINES MEDICAL CAMPUS**  
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**FIGURE A-9**  
 1 of 3

BOREHOLE LOG 242078.03 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION	SAMPLES				GRAPH				COMMENTS	Elevation (feet)	
			Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot)* or (Rock Quality)	■ BLOW COUNT 20 40 60 80	● POCKET PEN (tsf) 1 2 3 4	▲ VANE SHEAR (tsf) 0.2 0.4 0.6 0.8	Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information		
20.0			CLAYEY SILT WITH SAND (S(CL-ML)) bluish gray, wet, subrounded to subangular gravel; fine sand(continued)	7	Sh		50	2-50					MC=18%	26.0
22.5			POORLY-GRADED SAND WITH SILT AND GRAVEL ((SP-SM)G) bluish gray, moist, subrounded to subangular gravel											23.5
25.0			POORLY-GRADED SAND WITH SILT AND GRAVEL ((SP-SM)G) bluish gray, moist, subrounded to subangular gravel	8	Sh		75	6-18-32-25 (50)					MC=12% MC=13%	21.0
27.5			POORLY-GRADED GRAVELLY SAND WITH SILT (G(SP-SM)) bluish gray, moist, subrounded to subangular gravel											18.5
30.0			POORLY-GRADED SANDY GRAVEL WITH SILT (S(GP-GM)) bluish gray, moist, subrounded to subangular gravel	9	Sh		84	5-17-22-30 (39)					MC=14%	16.0
32.5			POORLY-GRADED SANDY GRAVEL WITH SILT (S(GP-GM)) bluish gray, moist, subrounded to subangular gravel											13.5
35.0			POORLY-GRADED SAND WITH SILT AND GRAVEL ((SP-SM)G) bluish gray, moist, subrounded gravel	10	Sh		67	8-15-24-23 (39)					MC=5%	11.0
37.5			POORLY-GRADED SAND WITH SILT AND GRAVEL ((SP-SM)G) bluish gray, moist, subrounded gravel											8.5
40.0														6.0



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SEARHC HAINES MEDICAL CAMPUS  
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FIGURE A-9  
2 of 3

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION	SAMPLES				GRAPH				COMMENTS	Elevation (feet)		
			Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot)* or (Rock Quality)	■ BLOW COUNT 20 40 60 80 ● POCKET PEN (tsf) 1 2 3 4 ▲ VANE SHEAR (tsf) 0.2 0.4 0.6 0.8					Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	
40.0			POORLY-GRADED SAND WITH SILT AND GRAVEL ((SP-SM)G) bluish gray, moist, subrounded gravel(continued)	11	Sh		50	11-19-20-17 (39)						MC=11%	-6.0
42.5															3.5
45.0				12	Sh		50	7-17-20-27 (37)						MC=15%	1.0
47.5			POORLY-GRADED SAND WITH SILT (SP-SM) bluish gray, moist, rounded gravel												-1.5
50.0				13	Sh		67	3-11-19-20 (30)						MC=14%	-4.0
52.5															-6.5
55.0															-9.0
57.5															-11.5
60.0														2' of heave at 60' bgs TOTAL DEPTH=60'	-14.0

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**FIGURE A-9**  
**3 of 3**

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH	COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)			
0.0			ORGANICS (PT) brown							34.5
2.5			WELL GRADED GRAVELLY SAND (G(SW)) bluish gray, subrounded gravel	1	Sh		50	5-3-1-0 (4)		32.0
5.0			CLAYEY SILT (CL-ML) bluish gray, subrounded gravel						MC=12% MC=17%	29.5
7.5			SANDY CLAYEY SILT (S(CL-ML)) bluish gray, subrounded gravel Gravel=6% Sand=39% Fines=55%	2	Sh		100	1-0-1-1 (1)*	VS = 0.20tsf MC=20%; PL=21 LL=17 *Spoon sank 4" after being placed.	27.0
10.0			CLAYEY SAND WITH SILT (SC-SM) bluish gray, subrounded gravel; coarse sand	3	Ts		0			24.5
12.5			CLAYEY SAND WITH SILT (SC-SM) bluish gray, subrounded gravel; coarse sand	4	Ts		0			22.0
15.0			CLAYEY SAND WITH SILT (SC-SM) bluish gray, subrounded gravel; coarse sand	5	Sh		100	0-0-0-17 (0)	VS = 0.16tsf Spoon sank 18" under weight of the hammer. MC=27%	19.5
17.5			CLAYEY SAND WITH SILT (SC-SM) bluish gray, subrounded gravel; coarse sand							17.0
20.0			CLAYEY SAND WITH SILT (SC-SM) bluish gray, subrounded gravel; coarse sand							14.5

BOREHOLE LOG 242078.03 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025



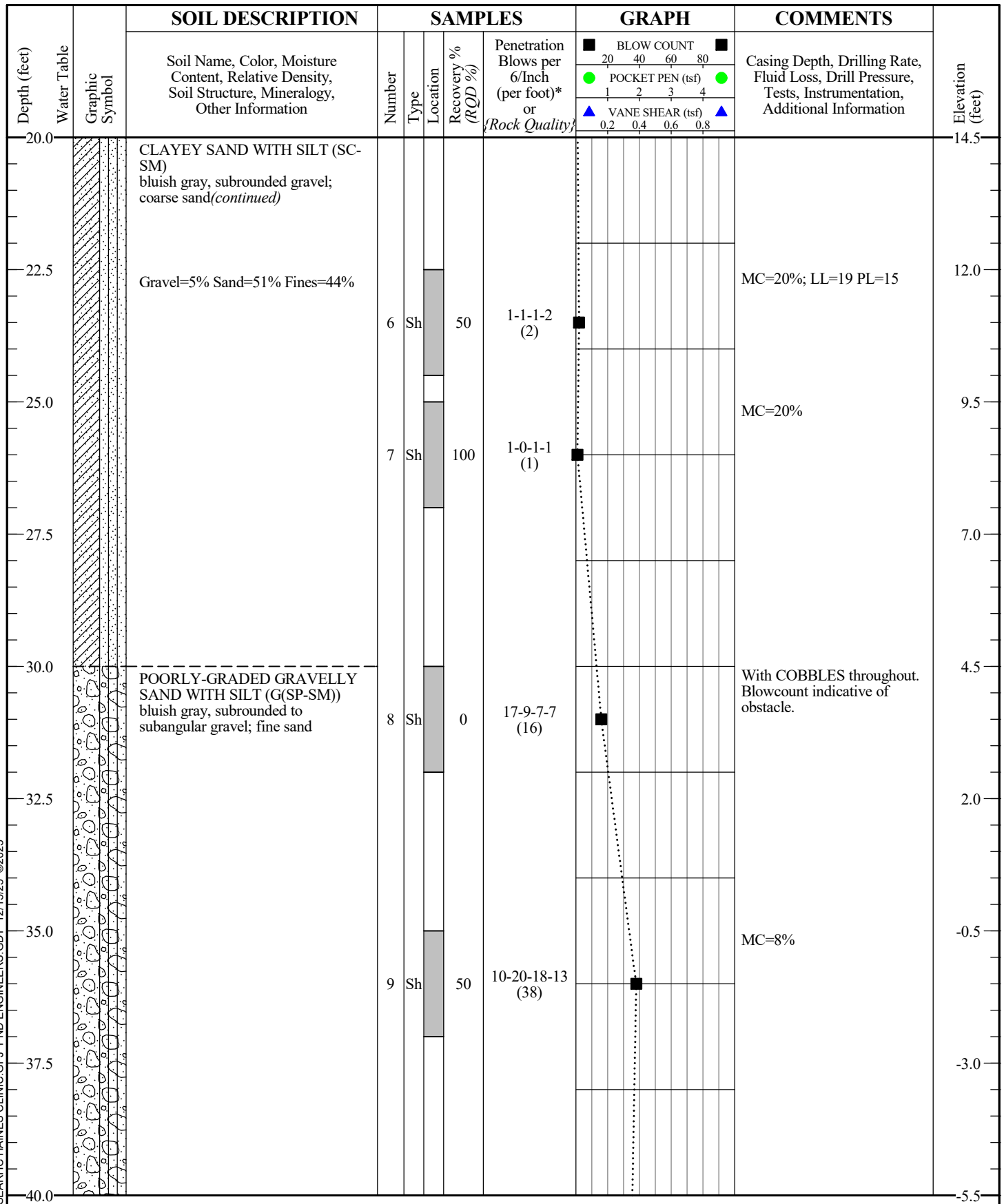
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FIGURE A-10  
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FIGURE A-10  
 2 of 3

BOREHOLE LOG 242078.03 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION	SAMPLES				GRAPH	COMMENTS	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)			
40.0			POORLY-GRADED GRAVELLY SAND WITH SILT (G(SP-SM)) bluish gray, subrounded to subangular gravel; fine sand(continued)	10	Sh	50	13-22-13-20 (35)		MC=10%	-5.5
42.5										
45.0										
47.5			POORLY-GRADED SANDY GRAVEL WITH SILT (S(GP-GM)) bluish gray, subrounded gravel; fine sand	11	Sh	50	12-25-38-35 (63)		MC=13%	-10.5
50.0										
52.5				12	Sh	34	12-27-28-50 (55)		MC=8%	-15.5
55.0										
57.5										
60.0										



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**FIGURE A-10**  
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BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	<div style="display: flex; justify-content: space-between;"> <span>■ BLOW COUNT ■</span> </div> <div style="display: flex; justify-content: space-between;"> <span>20 40 60 80</span> </div> <div style="display: flex; justify-content: space-between;"> <span>● POCKET PEN (tsf) ●</span> </div> <div style="display: flex; justify-content: space-between;"> <span>1 2 3 4</span> </div> <div style="display: flex; justify-content: space-between;"> <span>▲ VANE SHEAR (tsf) ▲</span> </div> <div style="display: flex; justify-content: space-between;"> <span>0.2 0.4 0.6 0.8</span> </div>				
0.0			ORGANICS dark brown, moist										59.0
2.5			SANDY GRAVEL (GP) brownish gray, moist										56.5
4.5	▽		SILTY SAND (SM) light bluish gray, moist										54.0
5.0			POORLY-GRADED SAND (SP) olive brown, wet, very fine to fine grained										51.5
8.0			Total Depth = 8' bgs									Walls sloughing, excavation terminated	49.0
10.0													46.5
12.5													44.0
15.0													41.5
17.5													39.0



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**SEARHC HAINES MEDICAL CAMPUS**  
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**TEST PIT TP-1**

**FIGURE B-11**  
**1 of 1**

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Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8		
0.0			ORGANICS dark brown									Hitachi 135 Excavator	52.7
2.5			SANDY GRAVEL (GP) brownish gray, dry, subrounded gravel; upper depth orange stained										50.2
5.0													47.7
7.5			POORLY-GRADED SAND (SP) olive brown, wet, very fine to fine grained										45.2
10.0													42.7
12.5													40.2
15.0													37.7
17.5			SILTY GRAVEL WITH SAND (GW) light bluish gray, moist, matrix supported diamict, hard digging; walls sloughing Total Depth = 17' bgs										35.2
20.0													32.7



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**SEARHC HAINES MEDICAL CAMPUS  
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**TEST PIT TP-2**

**FIGURE B-12  
1 of 1**

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION	SAMPLES				GRAPH				COMMENTS	Elevation (feet)	
			Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8			Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information
0.0			ORGANICS dark brown										Hitachi 135 Excavator	57.5
2.5			SANDY GRAVEL (GP) coarse, subrounded gravel											55.0
5.0														52.5
7.5														50.0
10.0														47.5
12.5														45.0
15.0			POORLY-GRADED SAND (SP) fine grained sand; walls sloughing											42.5
17.5			Total Depth = 16' bgs											40.0
20.0														37.5



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**SEARHC HAINES MEDICAL CAMPUS**  
**Haines, Alaska**

**TEST PIT TP-3**

**FIGURE B-13**  
**1 of 1**

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES					GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80 ● POCKET PEN (tsf) ● 1 2 3 4 ▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8					
0.0			ORGANICS dark brown											47.6
2.5			SANDY SILT WITH GRAVEL (ML) light gray, dry, desiccated, coarse clumps; lacustrine deposits											45.1
5.0			POORLY-GRADED SAND WITH GRAVEL (SP) reddish brown mottled with orange, dry, coarse, subrounded gravel											42.6
7.5			POORLY-GRADED SAND (SP) light olive brown, dry to wet											40.1
10.0														37.6
12.5														35.1
15.0												walls sloughing		32.6
17.5			Total Depth = 16' bgs											30.1
20.0														27.6

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**SEARHC HAINES MEDICAL CAMPUS  
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**TEST PIT TP-4**

**FIGURE B-14  
1 of 1**

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Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8		
0.0			ORGANICS dark brown									Hitachi 135 Excavator	46.5
			SILTY SAND (SM) dark brown										
2.5			UNKNOWN white, dry, pulverized - gritty; ash-like appearance										44.0
			POORLY-GRADED SAND (SP) tan, dry										
			SILT (ML) olive brown, moist, organics - plant roots; lacustrine deposits?										41.5
5.0													
7.5													39.0
			SILTY GRAVEL WITH SAND (GM) bluish gray, moist, matrix supported diamict; hard										
10.0			GRAVELLY SAND (SP) tan, wet										36.5
12.5													34.0
15.0													31.5
17.5			Total Depth = 16' bgs										29.0
20.0													26.5



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SEARHC HAINES MEDICAL CAMPUS  
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TEST PIT TP-5

FIGURE B-15  
1 of 1

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES					GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or {Rock Quality}	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8			
0.0			ORGANICS										Hitachi 135 Excavator	46.2
			SANDY GRAVEL (GP) light gray, dry, fine to medium, flat gravel											
2.5			SANDY GRAVEL (GP) dark reddish brown mottled with orange, dry, coarse to medium, subrounded gravel; distinct FeO stained; ferricrete											43.7
5.0														41.2
7.5			SILTY CLAY (ML/CL) light bluish gray, soft - toothpaste consistency											38.7
			Total Depth = 8' bgs											
10.0														36.2
12.5														33.7
15.0														31.2
17.5														28.7
20.0														26.2

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**Haines, Alaska**

**TEST PIT TP-6**

**FIGURE B-16**  
**1 of 1**

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80 ● POCKET PEN (tsf) ● 1 2 3 4 ▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8				
0.0			ORGANICS dark brown, wet, boggy surface; skunk cabbage										43.5
2.5			SANDY GRAVEL (GM) light gray, moist, fine to medium, subangular, flat gravel										41.0
5.0			SILTY CLAY (ML/CL) light bluish gray, moist, soft, toothpaste consistency										38.5
7.5													36.0
10.0													33.5
12.5													31.0
15.0													28.5
17.5			Total Depth = 16' bgs										26.0
20.0													23.5

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**SEARHC HAINES MEDICAL CAMPUS**  
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**TEST PIT TP-7**

**FIGURE B-17**  
**1 of 1**

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80 ● POCKET PEN (tsf) ● 1 2 3 4 ▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8				
0.0			ORGANICS dark brown, moist										45.5
			POORLY-GRADED GRAVEL (GM) light gray, dry, fine, subangular gravel; pea gravel in appearance										
2.5			SANDY GRAVEL (GP) dark reddish brown mottled with orange, dry, coarse to medium, subrounded gravel; distinct FeO staining; ferricrete										43.0
5.0			POORLY-GRADED SAND (SP) grayish brown, moist, coarse grained sand										40.5
7.5			SILTY CLAY (ML/CL) light bluish gray, soft toothpaste consistency										38.0
10.0													35.5
12.5													33.0
15.0													30.5
17.5													28.0
20.0			Total Depth = 18' bgs										25.5

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TEST PIT TP-8

FIGURE B-18  
1 of 1

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8		
0.0			ORGANICS dark brown, wet, boggy surface, abundant skunk cabbage										39.0
2.5			POORLY-GRADED GRAVEL WITH SAND (GP) light gray, wet, fine, flat gravel										36.5
5.0			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown, wet, coarse, subrounded gravel; abundant cobbles and boulders to 3'; distinct FeO staining										34.0
7.5			SILTY CLAY (ML/CL) light bluish gray, soft toothpaste consistency										31.5
10.0													29.0
12.5													26.5
15.0													24.0
17.5													21.5
20.0			Total Depth = 18' bgs										19.0



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**SEARHC HAINES MEDICAL CAMPUS**  
**Haines, Alaska**

**TEST PIT TP-9**

**FIGURE B-19**  
**1 of 1**

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8		
0.0			ORGANICS dark brown									Hitachi 135 Excavator	46.5
2.5			POORLY-GRADED GRAVEL (GP) light gray, dry, fine, subangular, flat gravel										44.0
5.0			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown, dry, distinct FeO staining; ferricrete										41.5
7.5			SILTY CLAY (ML/CL) light bluish gray										39.0
10.0			Total Depth = 7' bgs; Dry - no water observed										36.5
12.5													34.0
15.0													31.5
17.5													29.0
20.0													26.5



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**SEARHC HAINES MEDICAL CAMPUS**  
**Haines, Alaska**

**TEST PIT TP-10**

**FIGURE B-20**  
**1 of 1**

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8		
0.0			ORGANICS dark brown									Hitachi 135 Excavator	33.6
2.5			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown mottled with orange, dry, coarse to medium, subrounded gravel; distinct FeO staining; ferricrete										31.1
5.0			SAND WITH SILT AND GRAVEL (SM) brownish gray, moist										28.6
7.5			SILTY CLAY (ML/CL) light bluish gray, soft toothpaste consistency										26.1
10.0													23.6
12.5													21.1
15.0													18.6
17.5													16.1
20.0			Total Depth = 18' bgs										13.6

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025



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SEARHC HAINES MEDICAL CAMPUS  
Haines, Alaska

TEST PIT TP-11

FIGURE B-21  
1 of 1

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8		
0.0			ORGANICS dark brown									Hitachi 135 Excavator	34.6
			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown, dry										
2.5			SANDY GRAVEL (GP) orange, dry										32.1
			SANDY GRAVEL (GP) olive gray, dry										
5.0			SILTY CLAY (ML/CL) light bluish gray, soft toothpaste consistency										29.6
			Total Depth = 6' bgs										
7.5													27.1
10.0													24.6
12.5													22.1
15.0													19.6
17.5													17.1
20.0													14.6

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025



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**SEARHC HAINES MEDICAL CAMPUS  
Haines, Alaska**

**TEST PIT TP-12**

**FIGURE B-22  
1 of 1**

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES					GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)	
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT	● POCKET PEN (tsf)	▲ VANE SHEAR (tsf)	■			●
0.0			ORGANICS dark brown												39.0
			POORLY-GRADED GRAVEL (GP) light gray, fine, subangular, flat gravel												
2.5			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown mottled with orange												36.5
			SANDY GRAVEL (GP) olive brown												
5.0			SILTY SAND WITH GRAVEL (SM) gray, lacustrine deposit?												34.0
			SILTY CLAY (ML/CL) light bluish gray, soft toothpaste consistency												
7.5			Total Depth = 7' bgs												31.5
10.0															29.0
12.5															26.5
15.0															24.0
17.5															21.5
20.0															19.0



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**SEARHC HAINES MEDICAL CAMPUS**  
**Haines, Alaska**

**TEST PIT TP-13**

**FIGURE B-23**  
**1 of 1**

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES					GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8			
0.0			ORGANICS										Hitachi 135 Excavator	36.2
2.5			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown											33.7
5.0			SILTY CLAY (ML/CL) light bluish gray											31.2
5.0			Total Depth = 5' bgs											28.7
7.5														26.2
10.0														23.7
12.5														21.2
15.0														18.7
17.5														16.2
20.0														



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**SEARHC HAINES MEDICAL CAMPUS**  
**Haines, Alaska**

**TEST PIT TP-14**

**FIGURE B-24**  
**1 of 1**

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8		
0.0			ORGANICS dark brown									Hitachi 135 Excavator	43.0
			POORLY-GRADED GRAVEL (GP) light gray										
2.5			SANDY GRAVEL (GP) dark reddish brown										40.5
			SILTY SAND (SM)										
5.0			SILTY CLAY (ML/CL) light bluish gray										38.0
			Total Depth = 6' bgs										
7.5													35.5
10.0													33.0
12.5													30.5
15.0													28.0
17.5													25.5
20.0													23.0

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025



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SEARHC HAINES MEDICAL CAMPUS  
Haines, Alaska

TEST PIT TP-15

FIGURE B-25  
1 of 1

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80 ● POCKET PEN (tsf) ● 1 2 3 4 ▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8				
0.0			ORGANICS										45.0
			POORLY-GRADED GRAVEL (GP) light gray										
2.5			POORLY-GRADED GRAVEL WITH SAND (GP) brown										42.5
5.0			SILTY CLAY (ML/CL) light bluish gray Total Depth = 5' bgs										40.0
7.5													37.5
10.0													35.0
12.5													32.5
15.0													30.0
17.5													27.5
20.0													25.0

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SEARHC HAINES MEDICAL CAMPUS  
Haines, Alaska

TEST PIT TP-16

FIGURE B-26  
1 of 1

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES					GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8			
0.0			ORGANICS										Hitachi 135 Excavator	45.0
			POORLY-GRADED GRAVEL (GP)											
			SANDY GRAVEL (GP) orange											
2.5			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown, crusty; distinct FeO; ferricrete											42.5
5.0			SILTY CLAY (ML/CL) light bluish gray Total Depth = 5' bgs											40.0
7.5														37.5
10.0														35.0
12.5														32.5
15.0														30.0
17.5														27.5
20.0														25.0

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025



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SEARHC HAINES MEDICAL CAMPUS  
Haines, Alaska

TEST PIT TP-17

FIGURE B-27  
1 of 1

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES					GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (ROD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8			
0.0			ORGANICS dark brown										Hitachi 135 Excavator	45.0
2.5			POORLY-GRADED GRAVEL WITH SAND (GP) orange											42.5
5.0			POORLY-GRADED SAND (SP) tan											40.0
7.5			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown											37.5
7.5			SILTY CLAY (ML/CL) light bluish gray Total Depth = 7' bgs											35.0
10.0														32.5
12.5														30.0
15.0														27.5
17.5														25.0
20.0														25.0

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025



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SEARHC HAINES MEDICAL CAMPUS  
Haines, Alaska

TEST PIT TP-18

FIGURE B-28  
1 of 1

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80 ● POCKET PEN (tsf) ● 1 2 3 4 ▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8				
0.0			ORGANICS dark brown										45.8
			POORLY-GRADED GRAVEL (GP) light gray										
2.5			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown, wet										43.3
5.0			POORLY-GRADED GRAVEL WITH SAND (GP) light gray and tan, wet										40.8
7.5			SILTY CLAY (ML/CL) light bluish gray Total Depth = 8' bgs										38.3
10.0													35.8
12.5													33.3
15.0													30.8
17.5													28.3
20.0													25.8

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SEARHC HAINES MEDICAL CAMPUS  
Haines, Alaska

TEST PIT TP-19

FIGURE B-29  
1 of 1

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES				GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)																		
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	<table border="1"> <tr> <td colspan="4">BLOW COUNT</td> </tr> <tr> <td>20</td> <td>40</td> <td>60</td> <td>80</td> </tr> </table>	BLOW COUNT				20	40	60	80	<table border="1"> <tr> <td colspan="4">POCKET PEN (tsf)</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> </table>	POCKET PEN (tsf)				1	2	3	4	<table border="1"> <tr> <td colspan="4">VANE SHEAR (tsf)</td> </tr> <tr> <td>0.2</td> <td>0.4</td> <td>0.6</td> <td>0.8</td> </tr> </table>	VANE SHEAR (tsf)			
BLOW COUNT																															
20	40	60	80																												
POCKET PEN (tsf)																															
1	2	3	4																												
VANE SHEAR (tsf)																															
0.2	0.4	0.6	0.8																												
0.0			ORGANICS										46.8																		
			POORLY-GRADED GRAVEL (GP) light gray, fine to medium, subangular, flat gravel																												
2.5			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown, wet, distinct FeO; ferricrete										44.3																		
5.0			POORLY-GRADED SAND WITH GRAVEL (SP) tan										41.8																		
7.5			SILTY CLAY (ML/CL) light bluish gray, large boulder at pit bottom  Total Depth = 6' bgs										39.3																		
10.0													36.8																		
12.5													34.3																		
15.0													31.8																		
17.5													29.3																		
20.0													26.8																		



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**SEARHC HAINES MEDICAL CAMPUS**  
**Haines, Alaska**

**TEST PIT TP-20**

**FIGURE B-30**  
**1 of 1**

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION	SAMPLES					GRAPH				COMMENTS	Elevation (feet)	
			Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8	Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information			
0.0			ORGANICS dark brown											Hitachi 135 Excavator	47.5
			POORLY-GRADED GRAVEL (GP) gray and brown, fine gravel												
2.5			POORLY-GRADED GRAVEL WITH SAND (GP) dark reddish brown												45.0
			SILTY CLAY (ML/CL) light bluish gray, cobbles and boulder to 3' at pit bottom Total Depth = 3' bgs												
5.0															42.5
7.5															40.0
10.0															37.5
12.5															35.0
15.0															32.5
17.5															30.0
20.0															27.5



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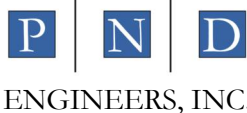
**SEARHC HAINES MEDICAL CAMPUS**  
**Haines, Alaska**

**TEST PIT TP-21**

**FIGURE B-31**  
**1 of 1**

BOREHOLE LOG 242078.01 SEARHC HAINES CLINIC.GPJ PND ENGINEERS.GDT 12/15/25 ©2025

Depth (feet)	Water Table	Graphic Symbol	SOIL DESCRIPTION Soil Name, Color, Moisture Content, Relative Density, Soil Structure, Mineralogy, Other Information	SAMPLES					GRAPH				COMMENTS Casing Depth, Drilling Rate, Fluid Loss, Drill Pressure, Tests, Instrumentation, Additional Information	Elevation (feet)
				Number	Type	Location	Recovery % (RQD %)	Penetration Blows per 6/Inch (per foot) or (Rock Quality)	■ BLOW COUNT ■ 20 40 60 80	● POCKET PEN (tsf) ● 1 2 3 4	▲ VANE SHEAR (tsf) ▲ 0.2 0.4 0.6 0.8			
0.0			ORGANICS dark brown										Hitachi 135 Excavator	48.4
			POORLY-GRADED GRAVEL WITH SAND (GP) orange											
2.5			SILT (ML) gray, lacustrine deposit?											
			POORLY-GRADED SAND WITH GRAVEL (SP) orange, at bottom pit, south end - light bluish gray clay with large broken marine shells exposed											45.9
5.0			Total Depth = 5' bgs											43.4
7.5														40.9
10.0														38.4
12.5														35.9
15.0														33.4
17.5														30.9
20.0														28.4



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**SEARHC HAINES MEDICAL CAMPUS**  
**Haines, Alaska**

**TEST PIT TP-22**

**FIGURE B-32**  
**1 of 1**

## Appendix B. Laboratory Test Results

# Summary of Sample Characteristics

**Client:** Southeast Alaska Regional Health Consortium  
**Project:** SEARHC Haines Medical Campus  
**Project #:** 242078



Borehole	Sample #	From	To	Sample Method	Liquid Limit (%)	Plastic Limit (%)	Gradation (%)			Max Particle Size (in)	Laboratory Classification*	Salinity (ppt)	Moisture (%)	Particle Shape	Angularity	Other Tests**
							Gravel	Sand	Fines*							
BH-1	1	2	4	Sh			25.0	43.9	0.7	2	SPg	10		SR		
BH-1	2	5	7	Sh			25.8	44.9	0.5	2	SPg	7		SR-SA		
BH-1	3	7.5	9.5	Sh						1.5	SPg	8		SR		
BH-1	4	11	13	Sh						1.5	SMg	12		SR		
BH-1	5	15	17	Sh						1/2	(SP-SM)g	18		SR		
BH-1	6	20	22	Sh			7.3	87.7	5.0	1.5	SP-SM	18		SR-SA		
BH-1	7	25	27	Sh							SP-SM	18				
BH-1	9	35	37	Sh						1	SP-SM	17		SR		
BH-1	10	40	42	Sh			4.5	84.2	11.3	1/2	SP-SM	20		SR		
BH-1	11	45	47	Sh						3/8	SP-SM	21		SR		
BH-5	1	0	2	Sh			47.0	48.3	4.7	1	gSW	16		SR		
BH-5	2	2.5	4.5	Sh			42.2	54.6	3.2	1	gSW	14		SR		
BH-5	3	5	7	Sh						1.5	s(GP-GM)	10		SR-SA		
BH-5	5	10	12	Sh	30	21	0.3	30.4	69.2		sCL	31				
BH-5	6	15	17	Sh	23	18	6.6	39.1	54.2	3/8	s(CL-ML)	22		SR		
BH-5	7	20	22	Sh						1.5	s(CL-ML)	18		SR-SA		
BH-5	8A	25	25.5	Sh						3/4	(SP-SM)g	12		SR-SA		
BH-5	8B	25.5	27	Sh						1	(SP-SM)g	13		SR-SA		
BH-5	9	30	32	Sh						1.5	g(SP-SM)	14		SR-SA		
BH-5	10	35	37	Sh						1.5	s(GP-GM)	5		SR-SA		
BH-5	11	40	42	Sh						3/4	(SP-SM)g	11		SR		
BH-5	12	45	47	Sh						1/2	(SP-SM)g	15		SR		
BH-5	13	50	52	Sh						3/8	SP-SM	14		R		
BH-9	1A	2.5	3.5	Sh						1	gSW	12		SR		
BH-9	1B	3.5	4.5	Sh							CL-ML	17				
BH-9	2	5	7	Sh	21	17	5.6	39.2	55.3	1	s(CL-ML)	20		SR		
BH-9	5	15	17	Sh						1	s(CL-ML)	27		SR		
BH-9	6	22.5	24.5	Sh	19	15	4.4	51.4	44.1	1/2	SC-SM	20		SR		
BH-9	7	25	27	Sh						1.5	SC-SM	20		SR		

\*Fines type and content estimated with ASTM D2488 when ASTM D422 or D4318 were not performed

\*\*Other tests: DEN = Bulk Density, SPG = Specific Gravity, HYD = Hydrometer, CONSL = Consolidation, UCS = Unconfined Compression Strength, TRIAX = Triaxial

# Summary of Sample Characteristics

**Client:** Southeast Alaska Regional Health Consortium  
**Project:** SEARHC Haines Medical Campus  
**Project #:** 242078



Borehole	Sample #	From	To	Sample Method	Liquid Limit (%)	Plastic Limit (%)	Gradation (%)			Max Particle Size (in)	Laboratory Classification*	Salinity (ppt)	Moisture (%)	Particle Shape	Angularity	Other Tests**
							Gravel	Sand	Fines*							
BH-9	9	35	37	Sh						1.5	g(SP-SM)	8		SR-SA		
BH-9	10	40	42	Sh						1	g(SP-SM)	10		SR-SA		
BH-9	11	45	47	Sh						3/4	g(SP-SM)	13		SR		
BH-9	12	50	52	Sh						1	s(GP-GM)	8		SR		

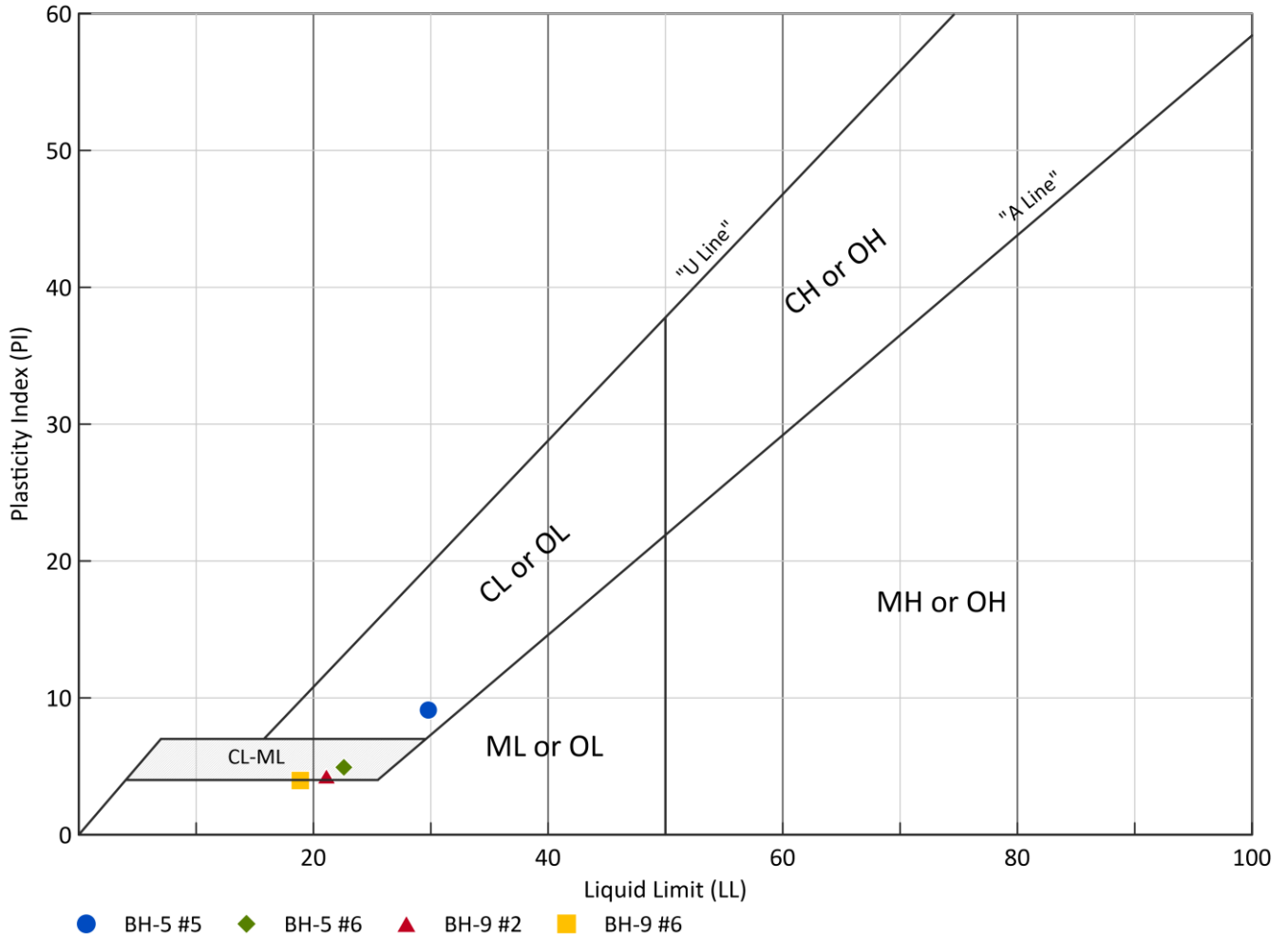
33 samples

\*Fines type and content estimated with ASTM D2488 when ASTM D422 or D4318 were not performed

\*\*Other tests: DEN = Bulk Density, SPG = Specific Gravity, HYD = Hydrometer, CONSL = Consolidation, UCS = Unconfined Compression Strength, TRIAX = Triaxial

# Atterberg Test Results

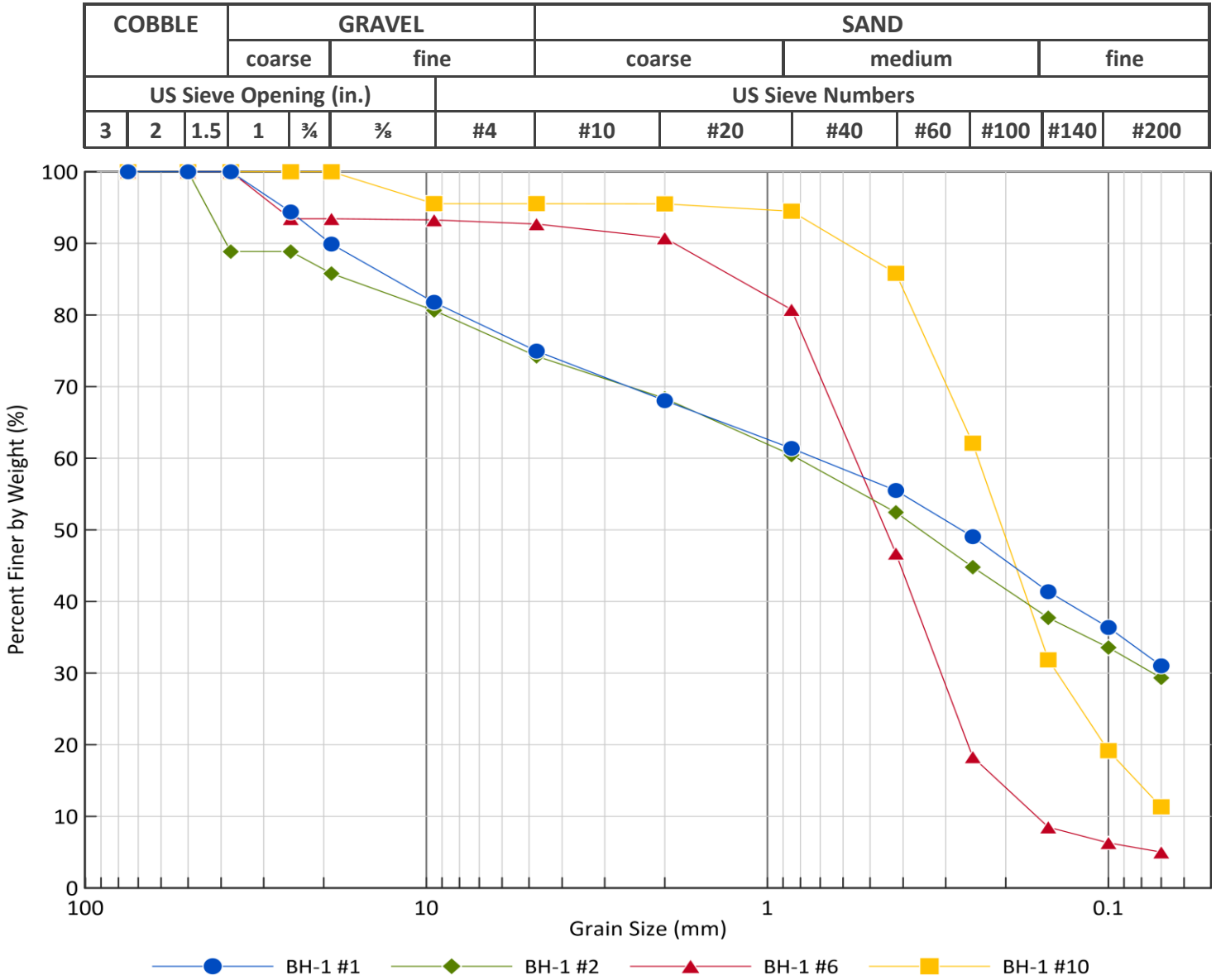
**Client:** Southeast Alaska Regional Health Consortium  
**Project:** SEARHC Haines Medical Campus  
**Project #:** 242078



Borehole	Sample #	From	To	Moisture %	LL	PL	PI	Fines Type
BH-5	5	10	12	30.86%	29.8	20.69	9.1	CL
BH-5	6	15	17	21.83%	22.6	17.66	4.9	CL-ML
BH-9	2	5	7	19.55%	21.1	16.84	4.3	CL-ML
BH-9	6	22.5	24.5	20.02%	18.9	14.92	4.0	ML

# Grain Size Distribution

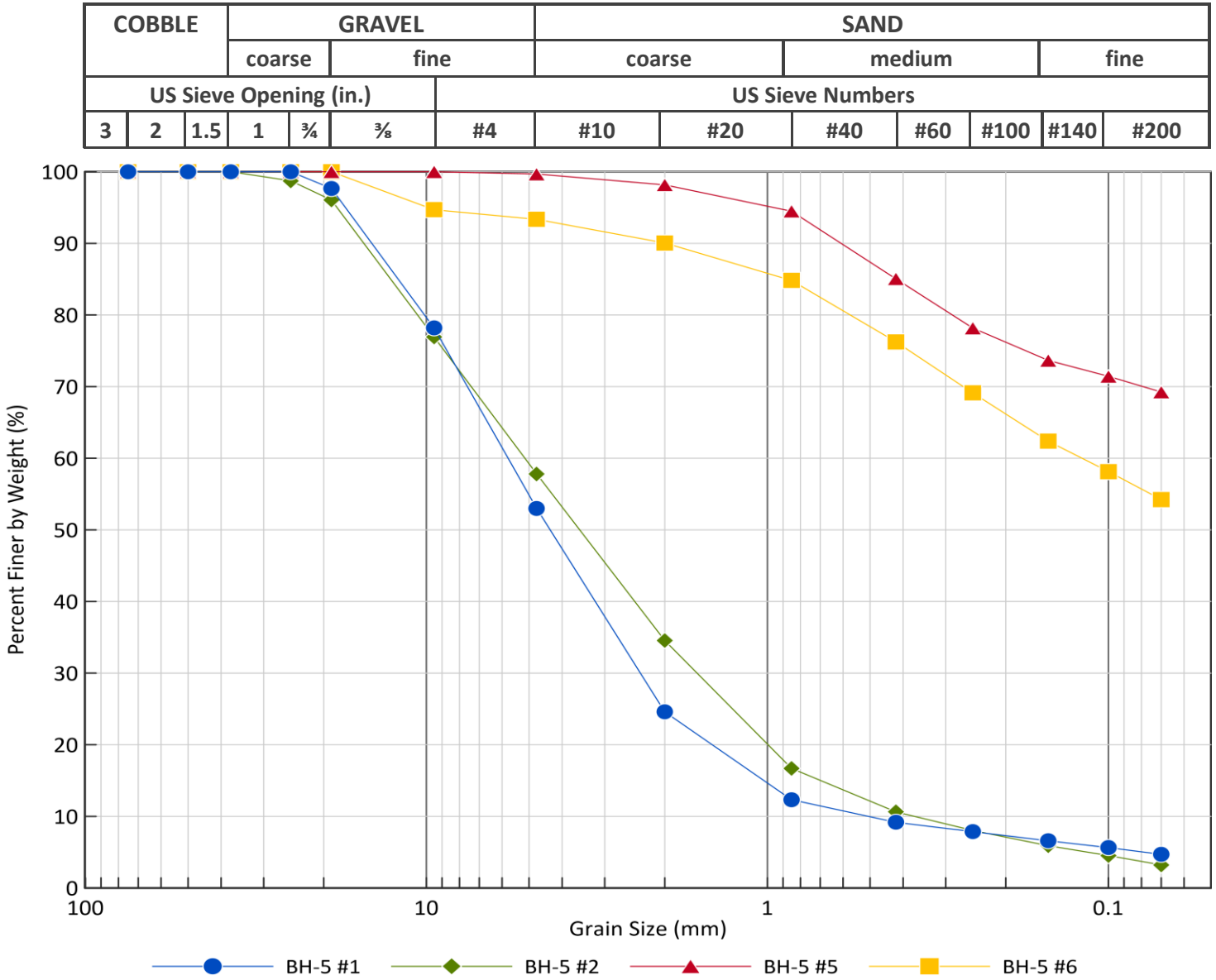
**Client:** Southeast Alaska Regional Health Consortium  
**Project:** SEARHC Haines Medical Campus  
**Project #:** 242078



\*Fines type estimated with ASTM D2488 when ASTM D422 or D4318 were not performed

# Grain Size Distribution

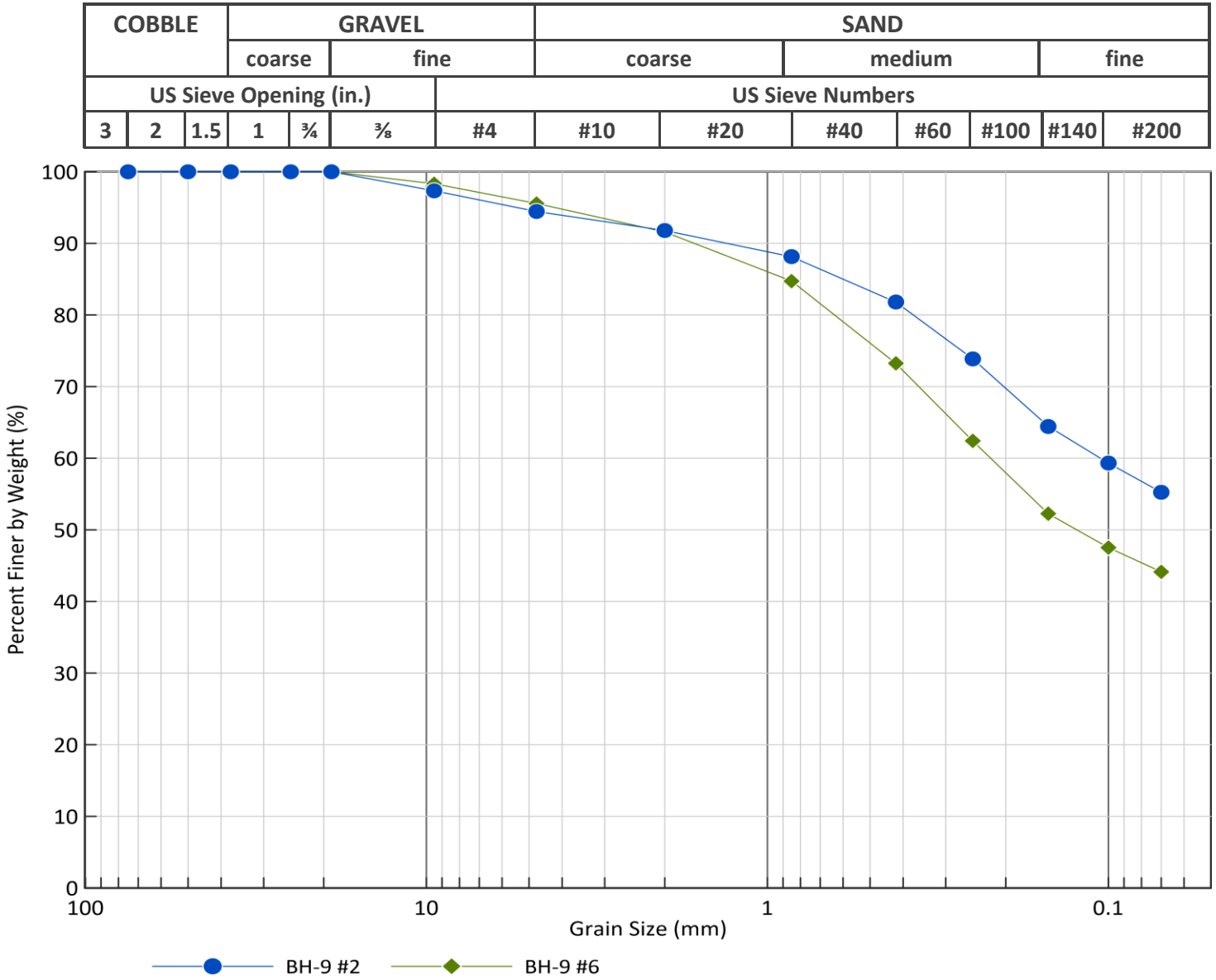
Client: Southeast Alaska Regional Health Consortium  
 Project: SEARHC Haines Medical Campus  
 Project #: 242078



\*Fines type estimated with ASTM D2488 when ASTM D422 or D4318 were not performed

# Grain Size Distribution

Client: Southeast Alaska Regional Health Consortium  
 Project: SEARHC Haines Medical Campus  
 Project #: 242078



Borehole	Sample #	From	To	Laboratory Classification*	Gradation (%)			D50	P10
					Gravel	Sand	Fines		
BH-9	2	5	7	s(CL-ML)	5.6	39.2	55.3		91.8
BH-9	6	22.5	24.5	SC-SM	4.4	51.4	44.1	0.1	91.6

\*Fines type estimated with ASTM D2488 when ASTM D422 or D4318 were not performed

## Appendix C. Slope Stability Results

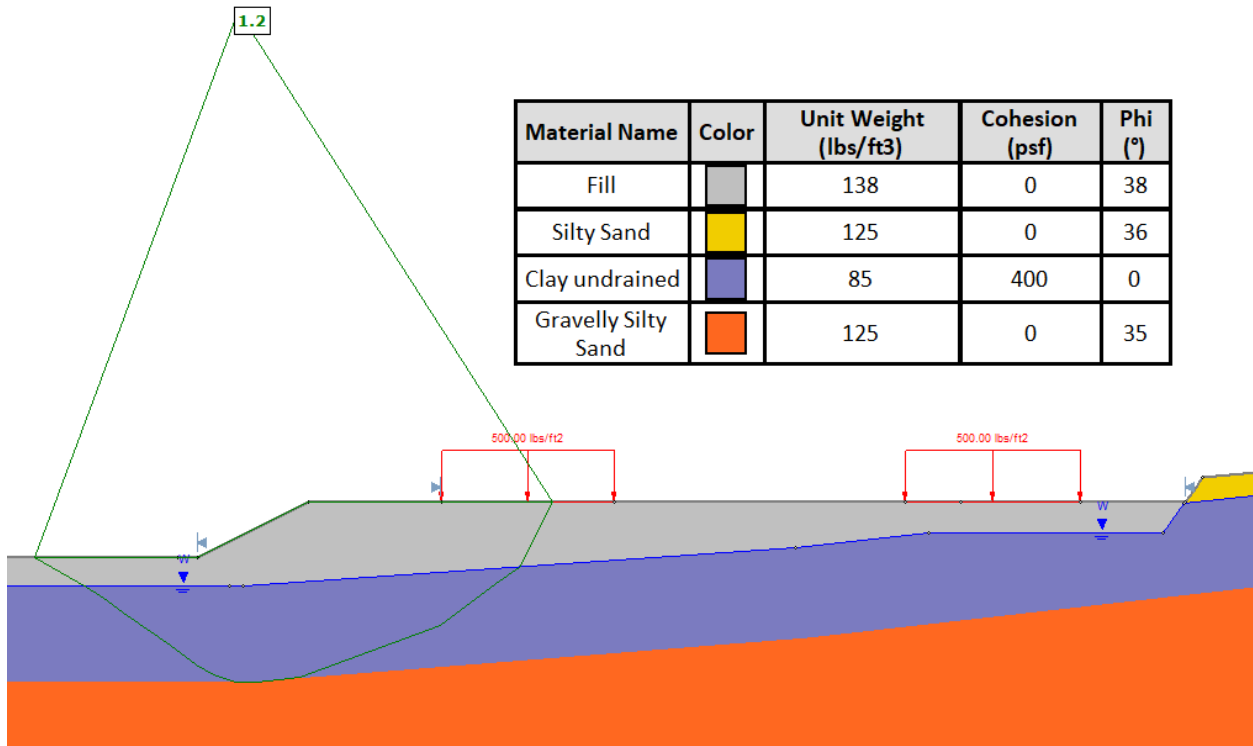


Figure C-1. Slope stability results using Rocscience’s Slide2 for the undrained static condition at the housing site

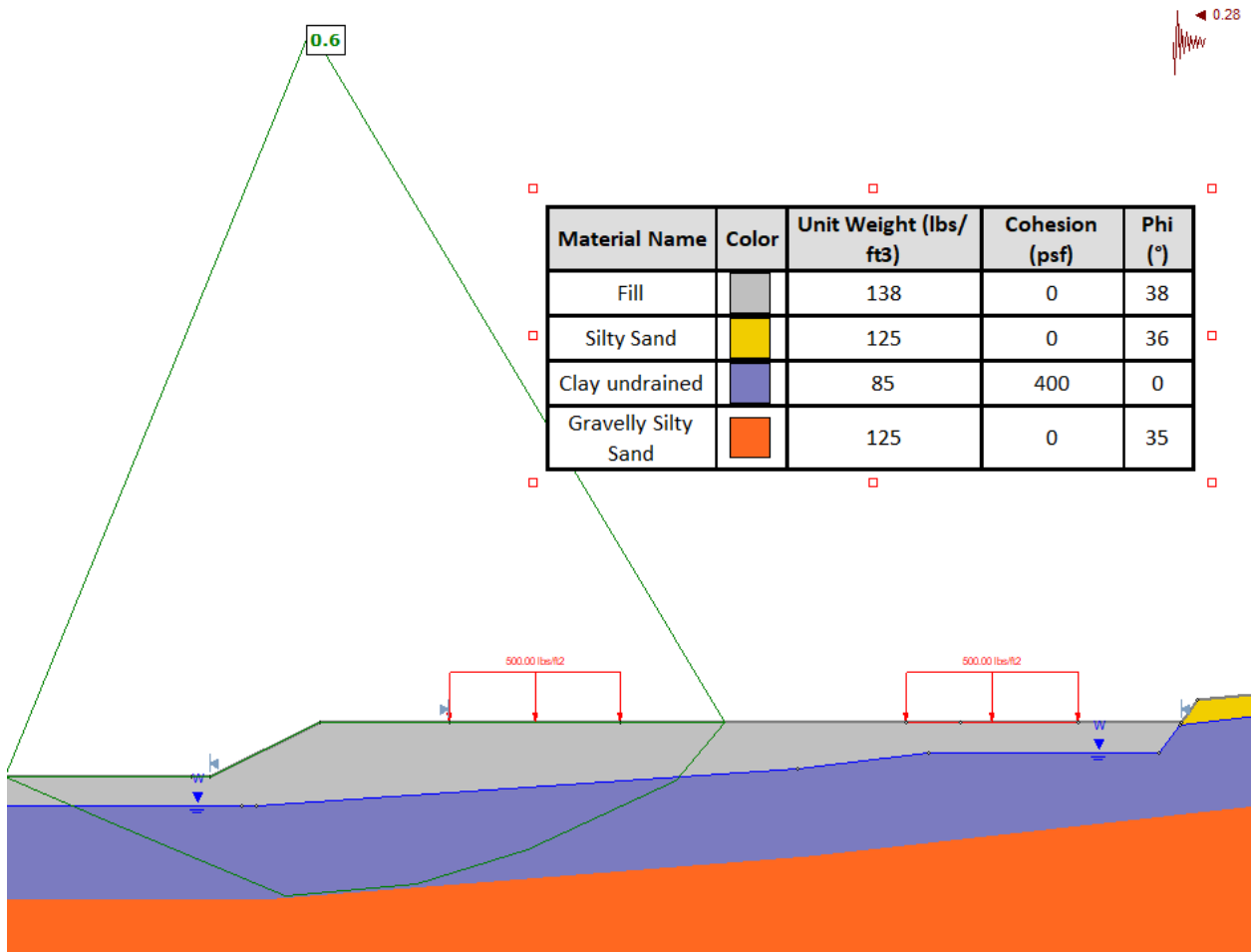


Figure C-2. Slope stability results using Rocscience’s Slide2 for the ***undrained*** seismic condition at the housing site

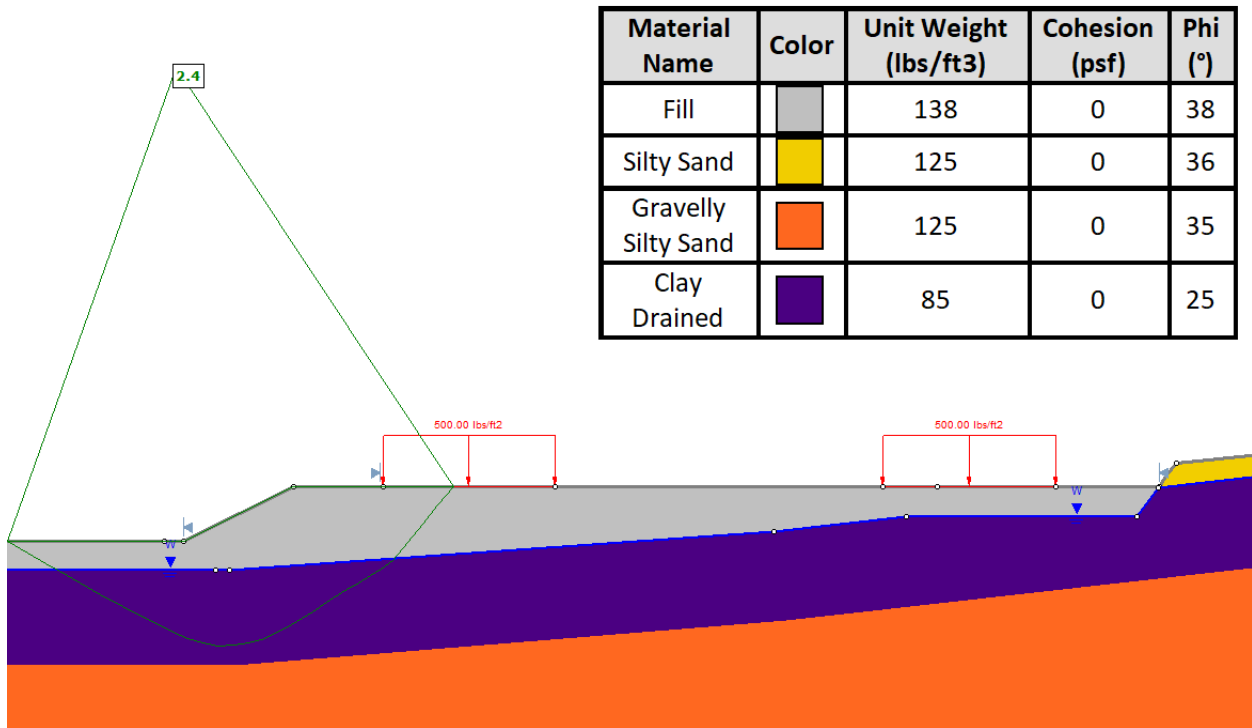


Figure C-3. Slope stability results using Rocscience’s Slide2 for the ***drained*** static condition at the housing site

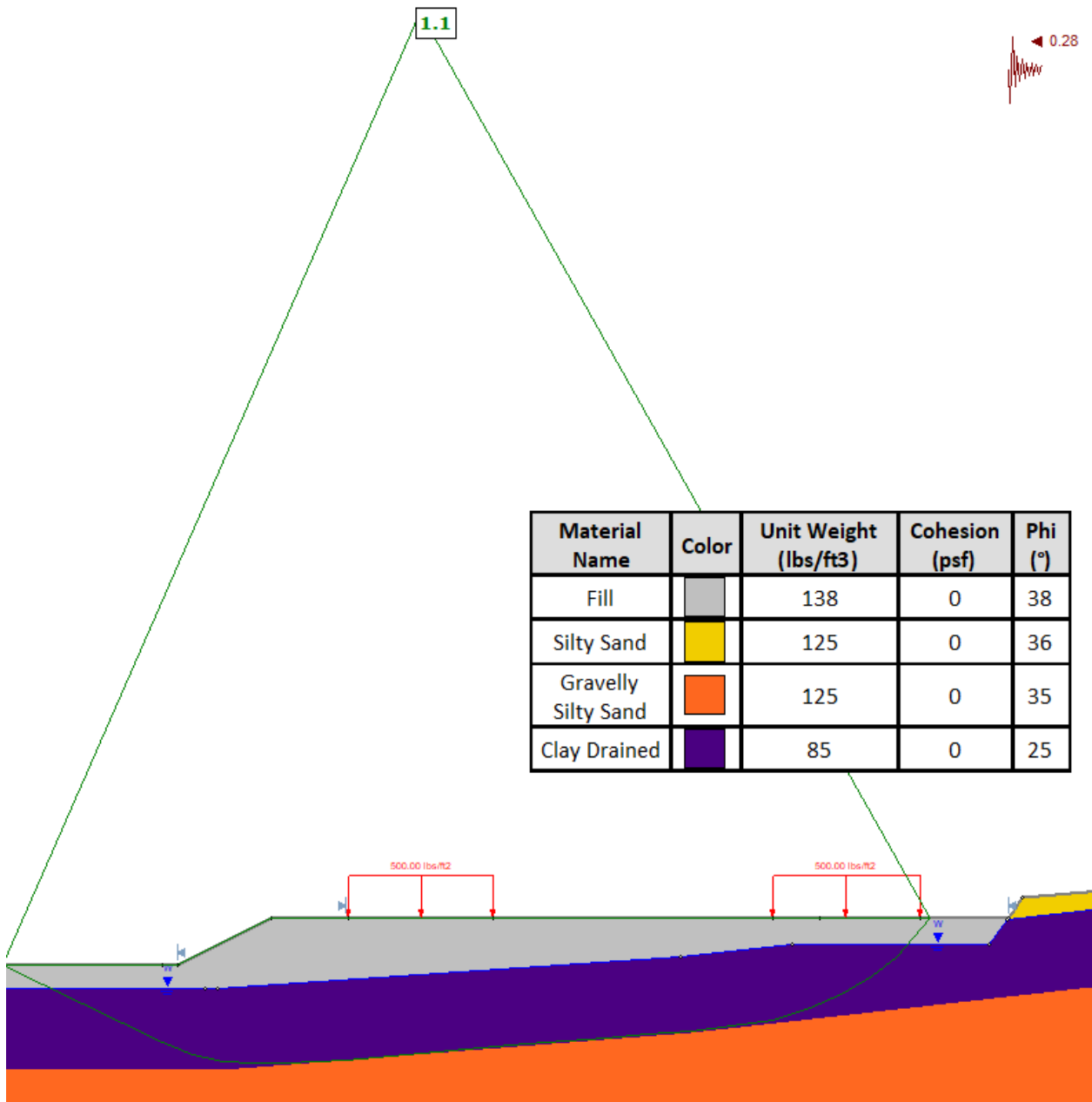
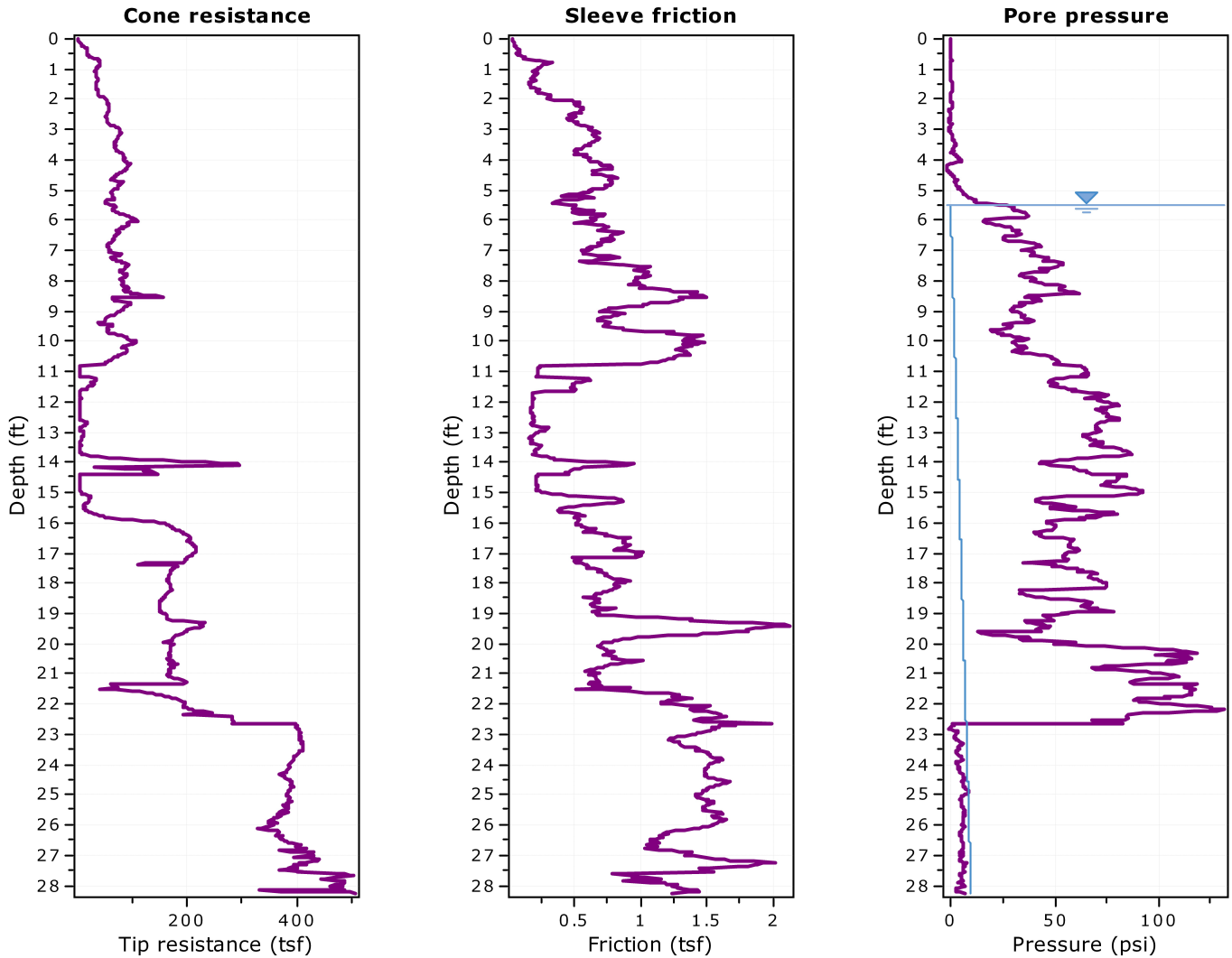
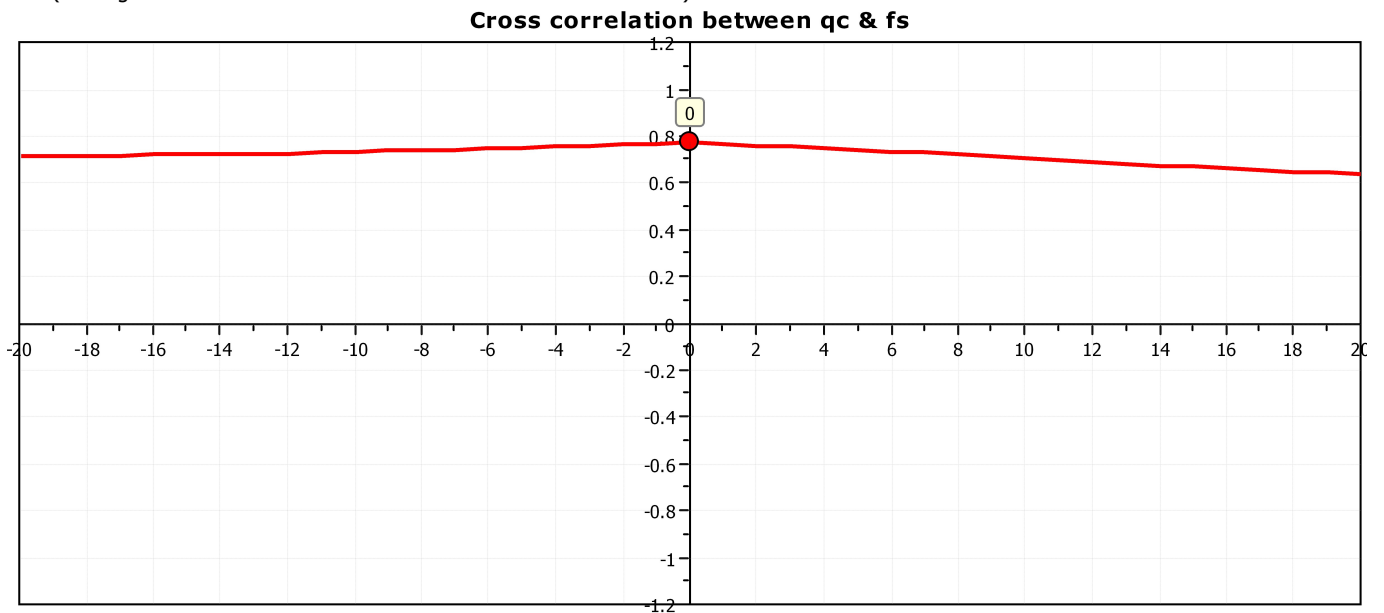


Figure C-4. Slope stability results using Rocscience's Slide2 for the drained seismic condition at the housing site

## Appendix D. CPT Output Results



The plot below presents the cross correlation coefficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).





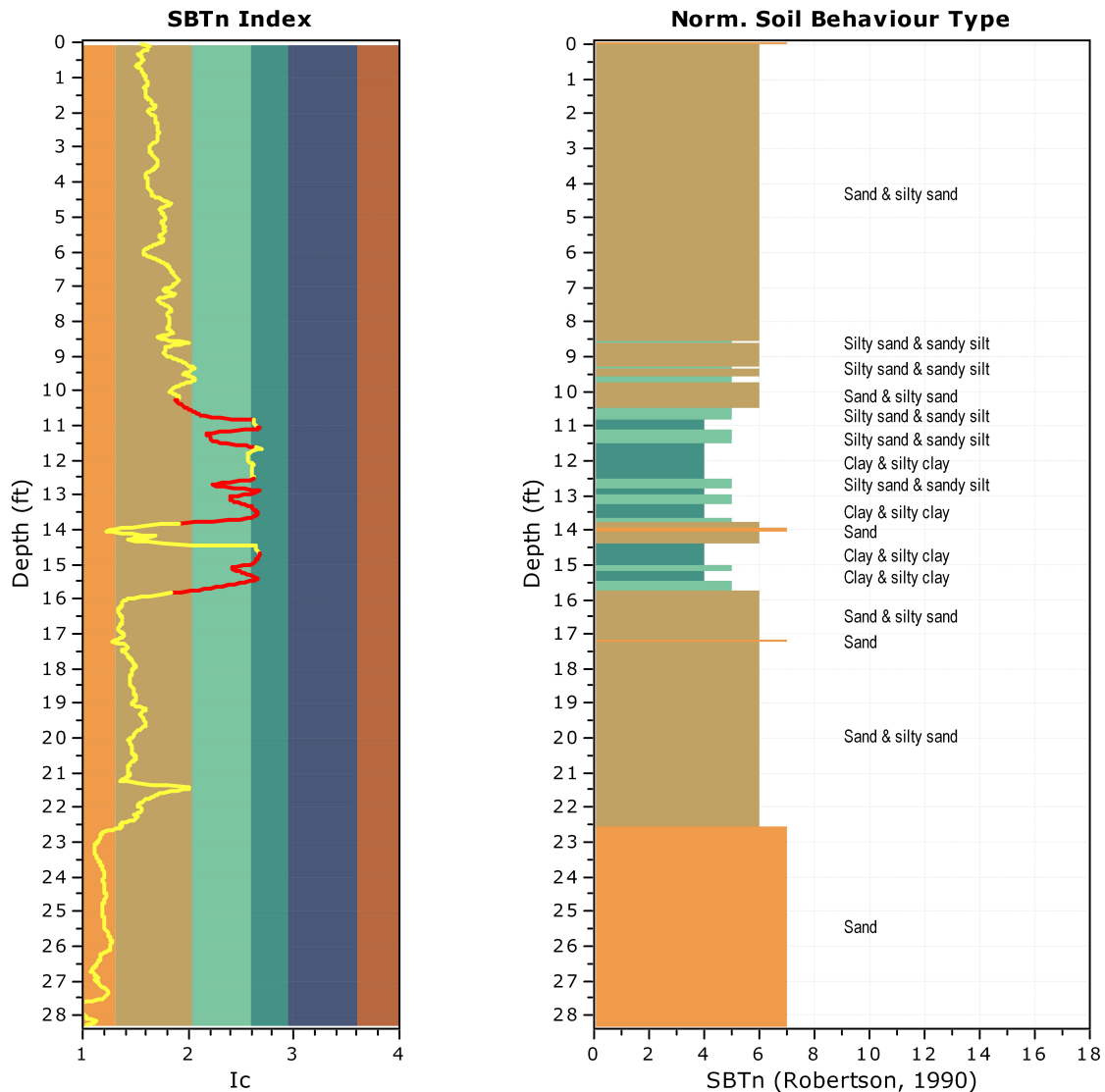
**TRANSITION LAYER DETECTION ALGORITHM REPORT**

**Summary Details & Plots**

**Short description**

The software will delete data when the cone is in transition from either clay to sand or vice-versa. To do this the software requires a range of  $I_c$  values over which the transition will be defined (typically somewhere between  $1.80 < I_c < 3.0$ ) and a rate of change of  $I_c$ . Transitions typically occur when the rate of change of  $I_c$  is fast (i.e.  $\Delta I_c$  is small).

The  $SBT_n$  plot below, displays in red the detected transition layers based on the parameters listed below the graphs.



**Transition layer algorithm properties**

$I_c$  minimum check value: 1.70  
 $I_c$  maximum check value: 3.00  
 $I_c$  change ratio value: 0.0010  
 Minimum number of points in layer: 4

**General statistics**

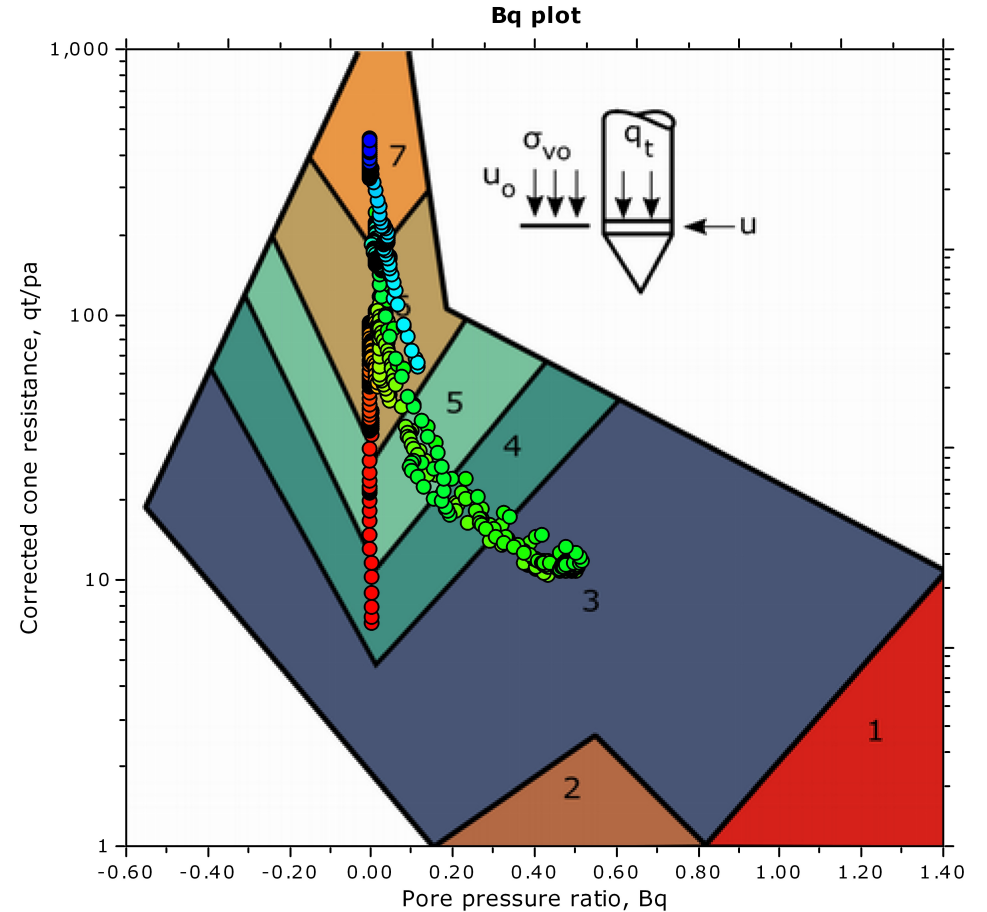
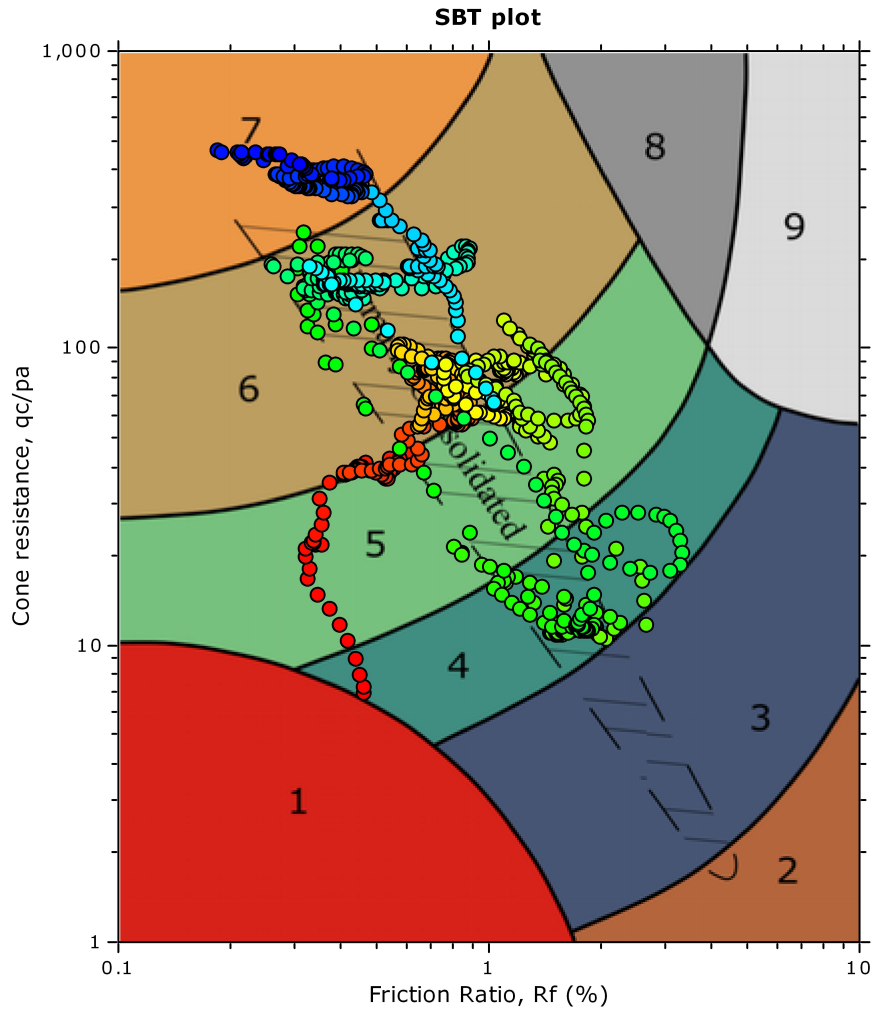
Total points in CPT file: 943  
 Total points excluded: 132  
 Exclusion percentage: 14.00%  
 Number of layers detected: 11

Transition layer No	Number of points	Depth	SBT <sub>n</sub> number	SBT <sub>n</sub> description
Transition layer 1	21	Start depth: 10.29 (ft)	6	Sand & silty sand
		End depth: 10.89 (ft)	4	Clay & silty clay
Transition layer 2	7	Start depth: 11.07 (ft)	4	Clay & silty clay
		End depth: 11.25 (ft)	5	Silty sand & sandy silt
Transition layer 3	15	Start depth: 11.25 (ft)	5	Silty sand & sandy silt
		End depth: 11.67 (ft)	4	Clay & silty clay
Transition layer 4	7	Start depth: 12.54 (ft)	4	Clay & silty clay
		End depth: 12.72 (ft)	5	Silty sand & sandy silt
Transition layer 5	7	Start depth: 12.72 (ft)	5	Silty sand & sandy silt
		End depth: 12.90 (ft)	4	Clay & silty clay
Transition layer 6	7	Start depth: 12.90 (ft)	4	Clay & silty clay
		End depth: 13.08 (ft)	5	Silty sand & sandy silt
Transition layer 7	16	Start depth: 13.08 (ft)	5	Silty sand & sandy silt
		End depth: 13.53 (ft)	4	Clay & silty clay
Transition layer 8	12	Start depth: 13.53 (ft)	4	Clay & silty clay
		End depth: 13.86 (ft)	6	Sand & silty sand
Transition layer 9	14	Start depth: 14.73 (ft)	4	Clay & silty clay
		End depth: 15.12 (ft)	5	Silty sand & sandy silt
Transition layer 10	10	Start depth: 15.12 (ft)	5	Silty sand & sandy silt
		End depth: 15.39 (ft)	4	Clay & silty clay
Transition layer 11	16	Start depth: 15.42 (ft)	4	Clay & silty clay
		End depth: 15.87 (ft)	6	Sand & silty sand

Start depth: Depth where the transition layer begins

End depth: Depth where the transition layer ends

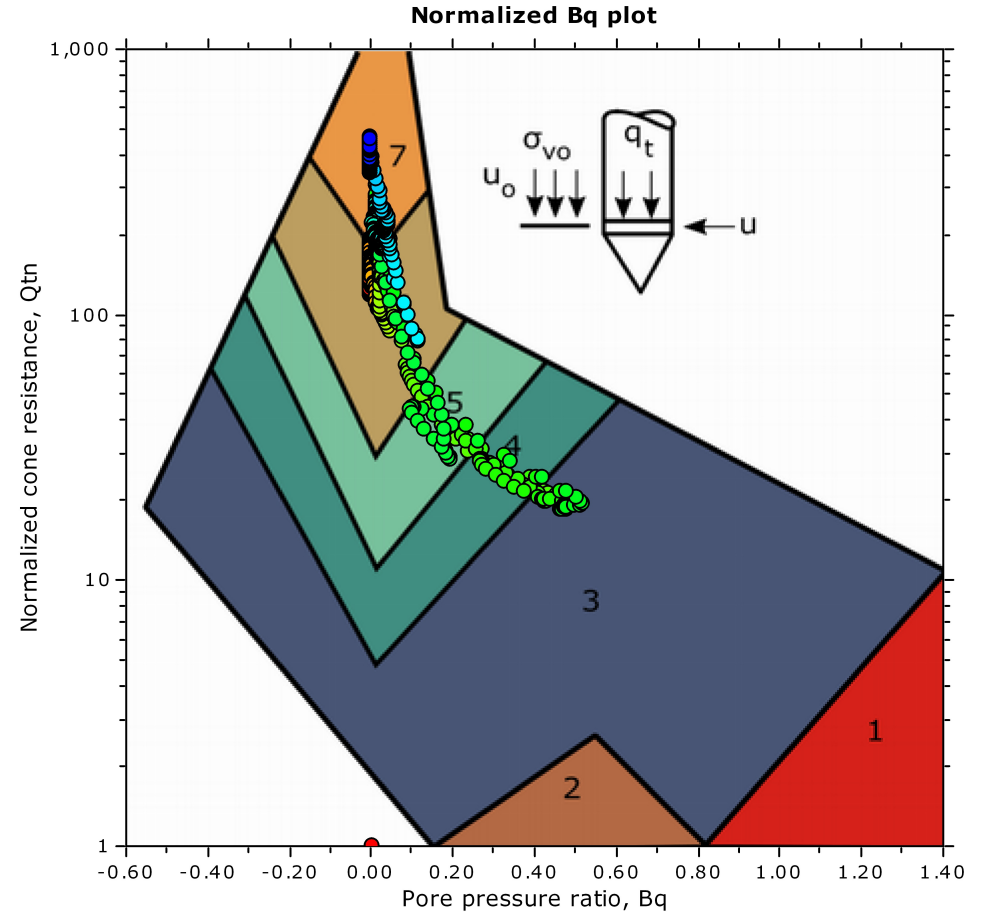
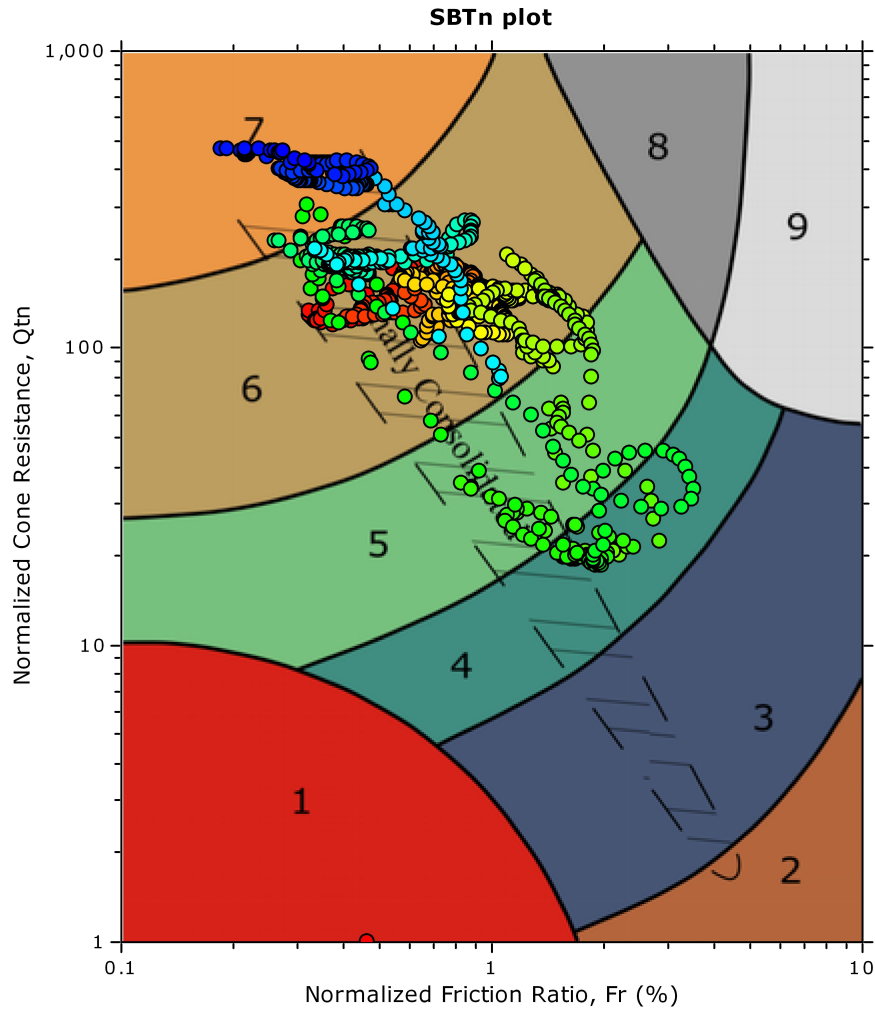
**SBT - Bq plots**



**SBT legend**

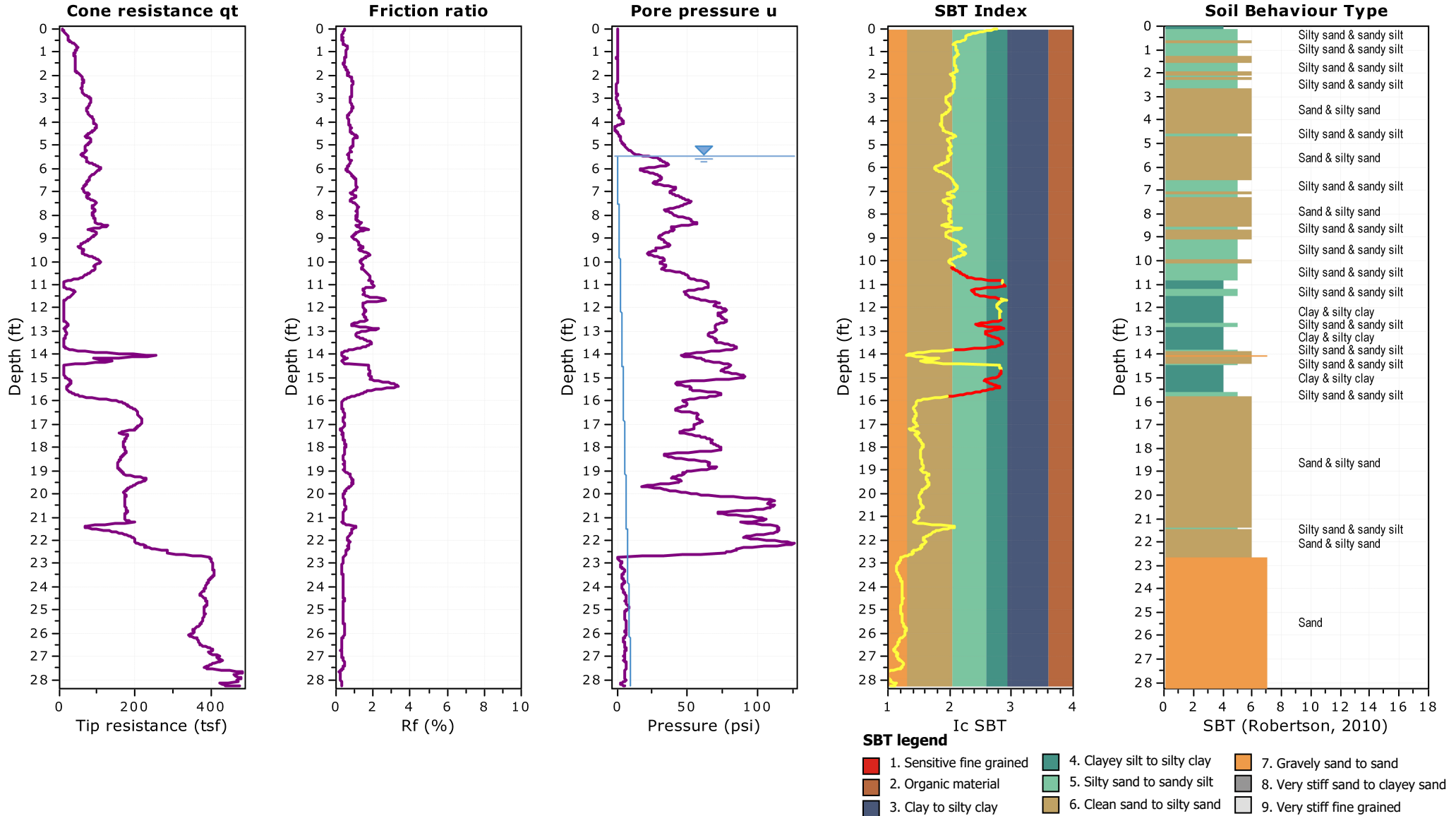
- |  |   |   |
|--|---|---|
| <span style="color: red;">■</span> 1. Sensitive fine grained | <span style="color: teal;">■</span> 4. Clayey silt to silty clay      | <span style="color: orange;">■</span> 7. Gravelly sand to sand        |
| <span style="color: brown;">■</span> 2. Organic material     | <span style="color: lightgreen;">■</span> 5. Silty sand to sandy silt | <span style="color: grey;">■</span> 8. Very stiff sand to clayey sand |
| <span style="color: blue;">■</span> 3. Clay to silty clay    | <span style="color: tan;">■</span> 6. Clean sand to silty sand        | <span style="color: lightgrey;">■</span> 9. Very stiff fine grained   |

**SBT - Bq plots (normalized)**



**SBTn legend**

- |  |   |   |
|--|---|---|
| <span style="color: red;">■</span> 1. Sensitive fine grained | <span style="color: teal;">■</span> 4. Clayey silt to silty clay      | <span style="color: orange;">■</span> 7. Gravelly sand to sand        |
| <span style="color: brown;">■</span> 2. Organic material     | <span style="color: lightgreen;">■</span> 5. Silty sand to sandy silt | <span style="color: grey;">■</span> 8. Very stiff sand to clayey sand |
| <span style="color: blue;">■</span> 3. Clay to silty clay    | <span style="color: tan;">■</span> 6. Clean sand to silty sand        | <span style="color: lightgrey;">■</span> 9. Very stiff fine grained   |





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 1506 W. 36th Ave.  
 Anchorage, AK 99503

ENGINEERS, INC.

**Project: SEARHC Haines Clinic Site Investigation**

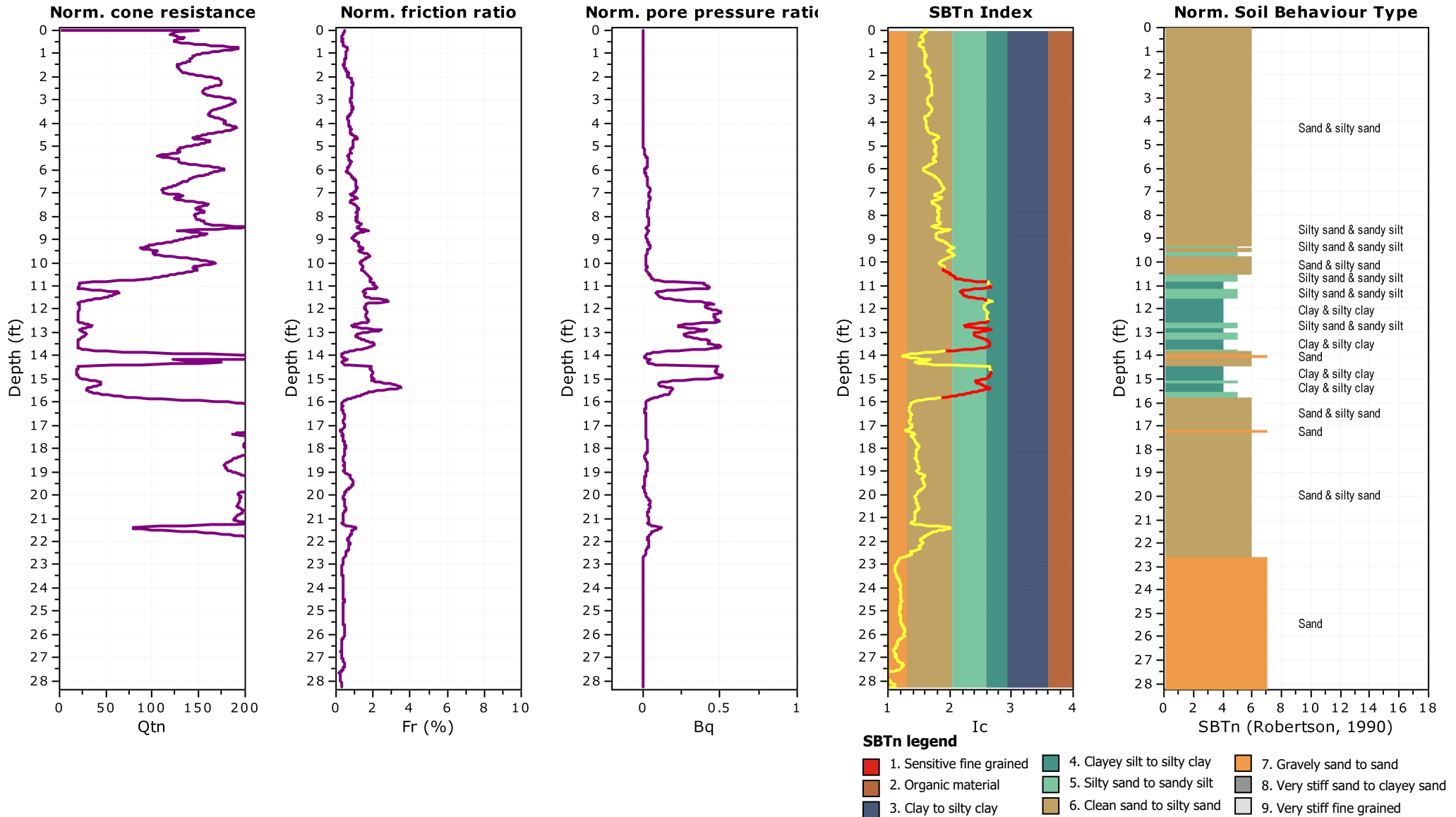
**Location: Haines, Alaska**

**CPT: Average CPT - Clinic**

Total depth: 28.26 ft, Date: 9/25/2025

Est. GWL: 5.50 ft

Cone Operator: Discovery Drilling, LLC





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**Project: SEARHC Haines Clinic Site Investigation**

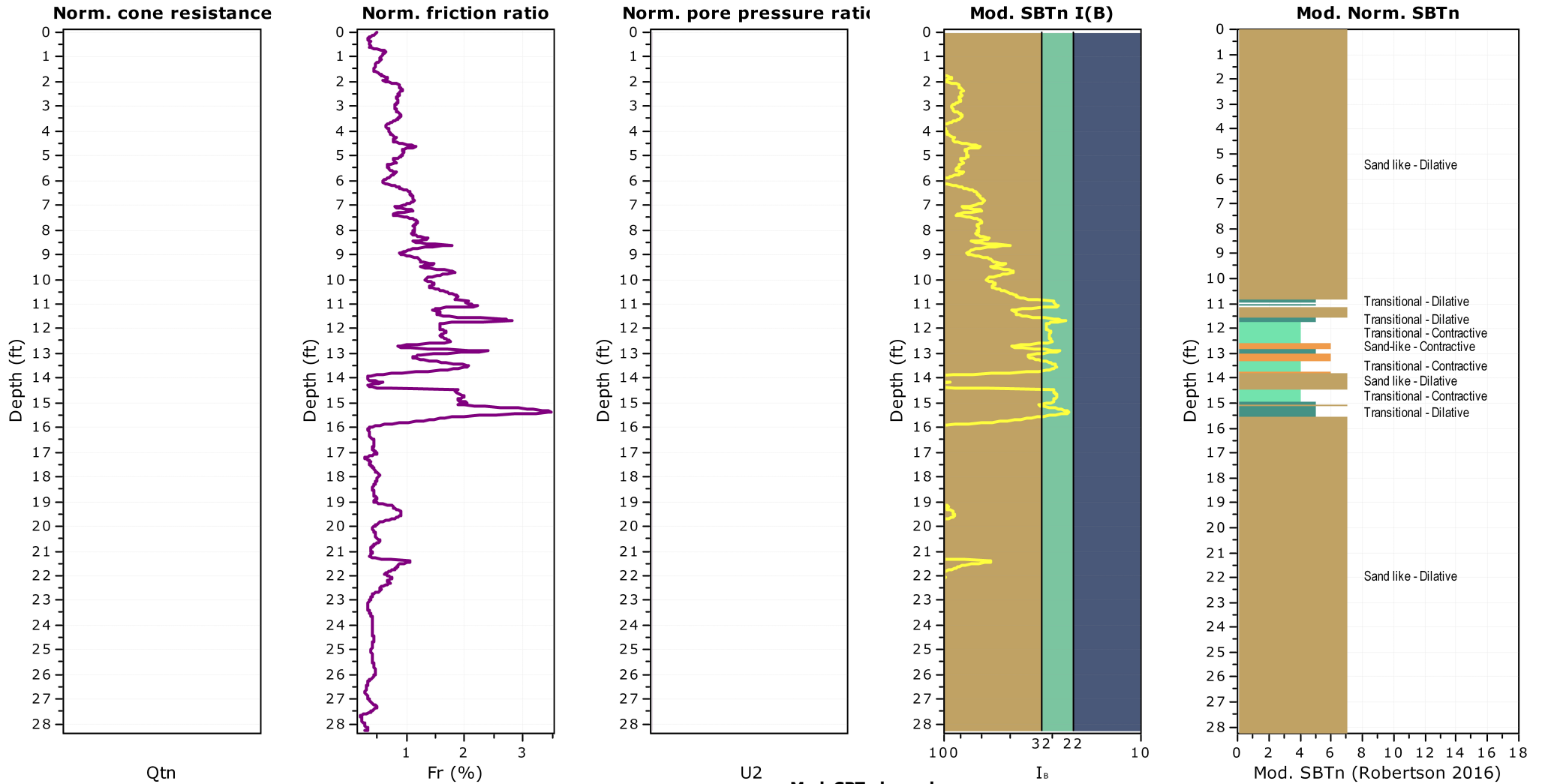
**Location: Haines, Alaska**

**CPT: Average CPT - Clinic**

Total depth: 28.26 ft, Date: 9/25/2025

Est. GWL: 5.50 ft

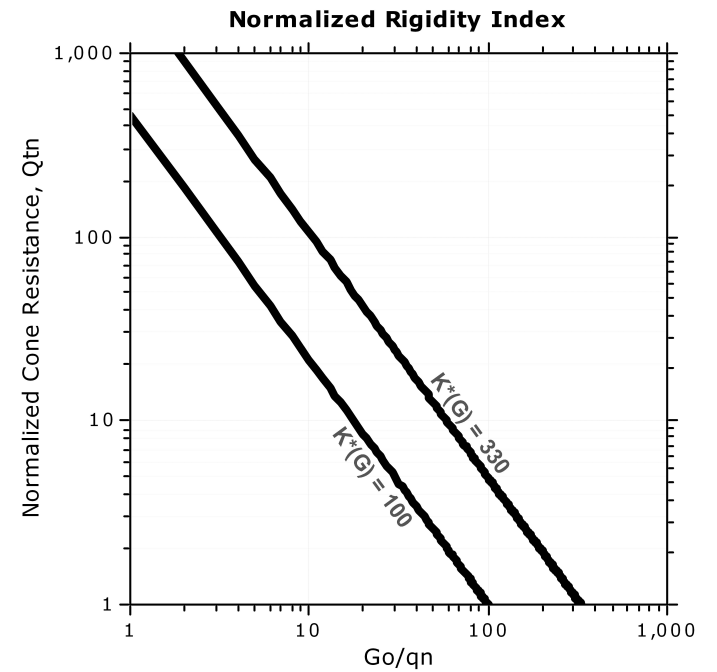
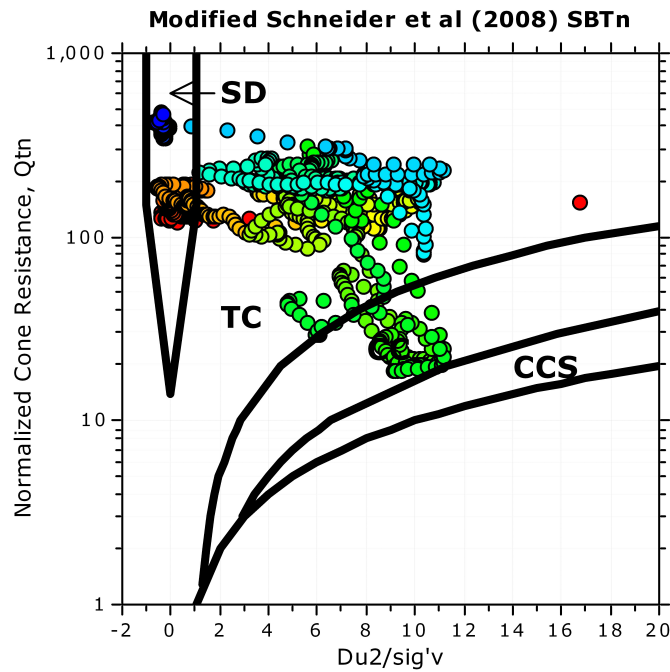
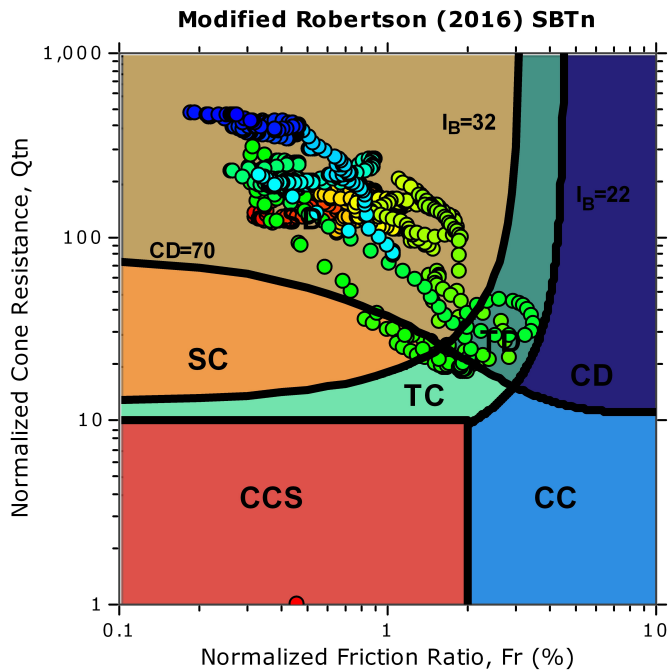
Cone Operator: Discovery Drilling, LLC



**Mod. SBTn legend**

- 1. CCS: ClayLike - Contractive, Sensitive
- 2. CC: Clay-like - Contractive
- 3. CD: Clay-Like: Dilative
- 4. TC: Transitional - Contractive
- 5. TD: Transitional - Dilative
- 6. SC: Sand-like - Contractive
- 7. SD: Sand-like - Dilative

**Updated SBTn plots**



- CCS: Clay-like - Contractive - Sensitive
- CC: Clay-like - Contractive
- CD: Clay-like - Dilative
- TC: Transitional - Contractive
- TD: Transitional - Dilative
- SC: Sand-like - Contractive
- SD: Sand-like - Dilative

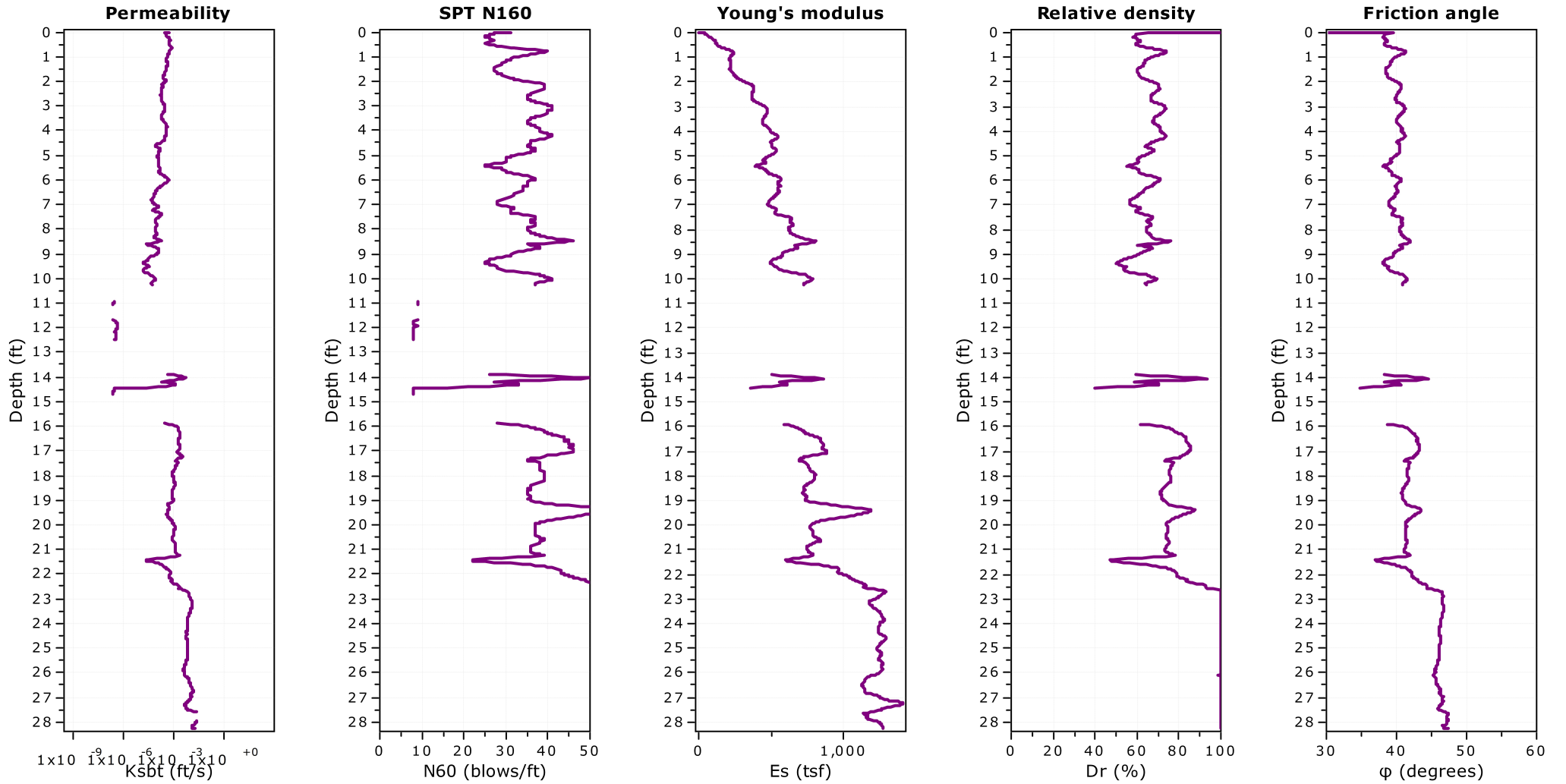
$K^*(G) > 330$ : Soils with significant microstructure (e.g. age/cementation)



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 Total depth: 28.26 ft, Date: 9/25/2025  
 Est. GWL: 5.50 ft  
 Cone Operator: Discovery Drilling, LLC



**Calculation parameters**

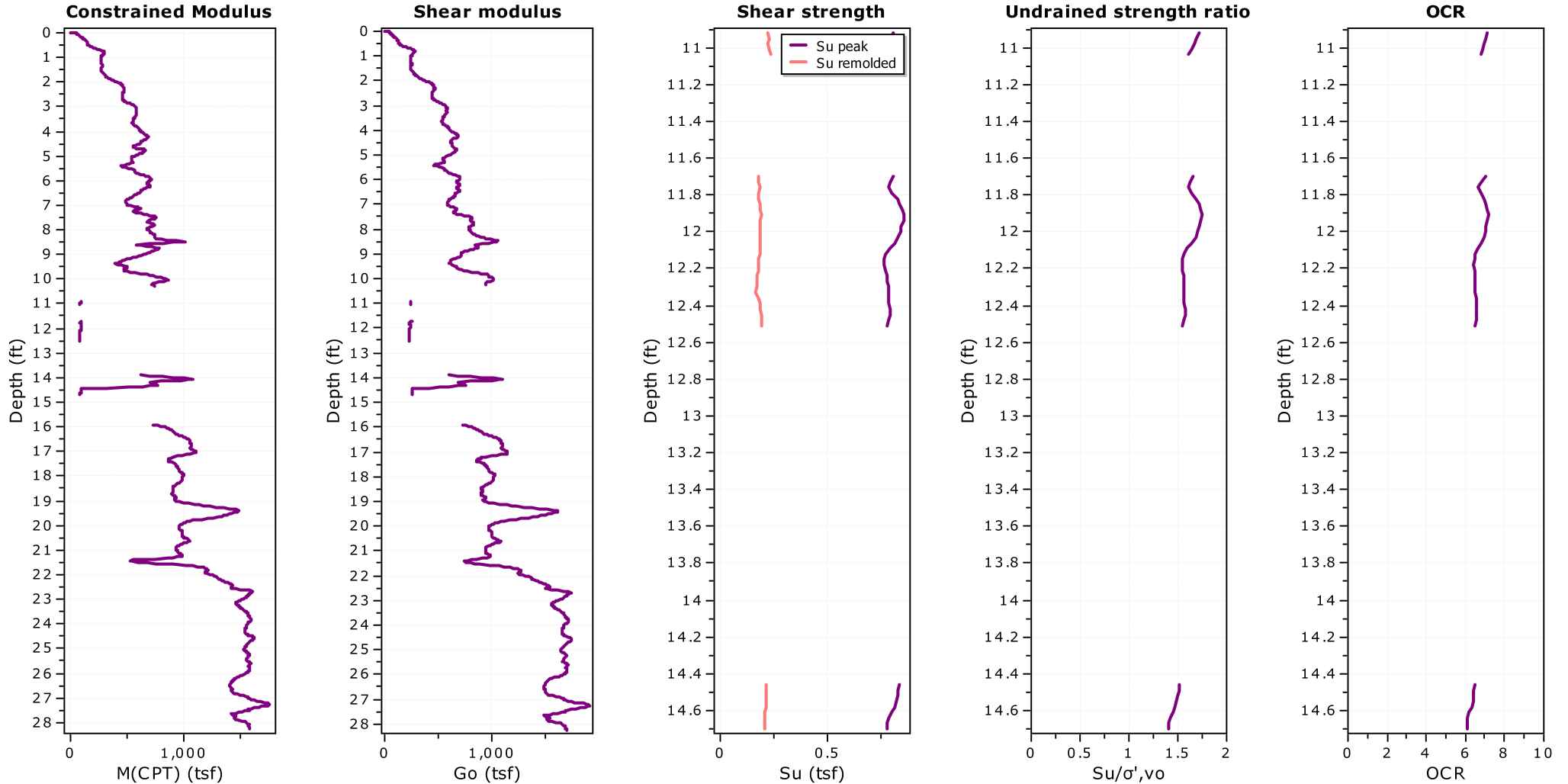
Permeability: Based on SBT<sub>n</sub>

SPT N<sub>60</sub>: Based on I<sub>c</sub> and q<sub>t</sub>

Young's modulus: Based on variable alpha using I<sub>c</sub> (Robertson, 2009)

Relative density constant, C<sub>Dr</sub>: 350.0

Phi: Based on Kulhawy & Mayne (1990)



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  using  $I_c$  (Robertson, 2009)

Undrained shear strength cone factor for clays,  $N_{kt}$ : 14

OCR factor for clays,  $N_{kr}$ : 0.33

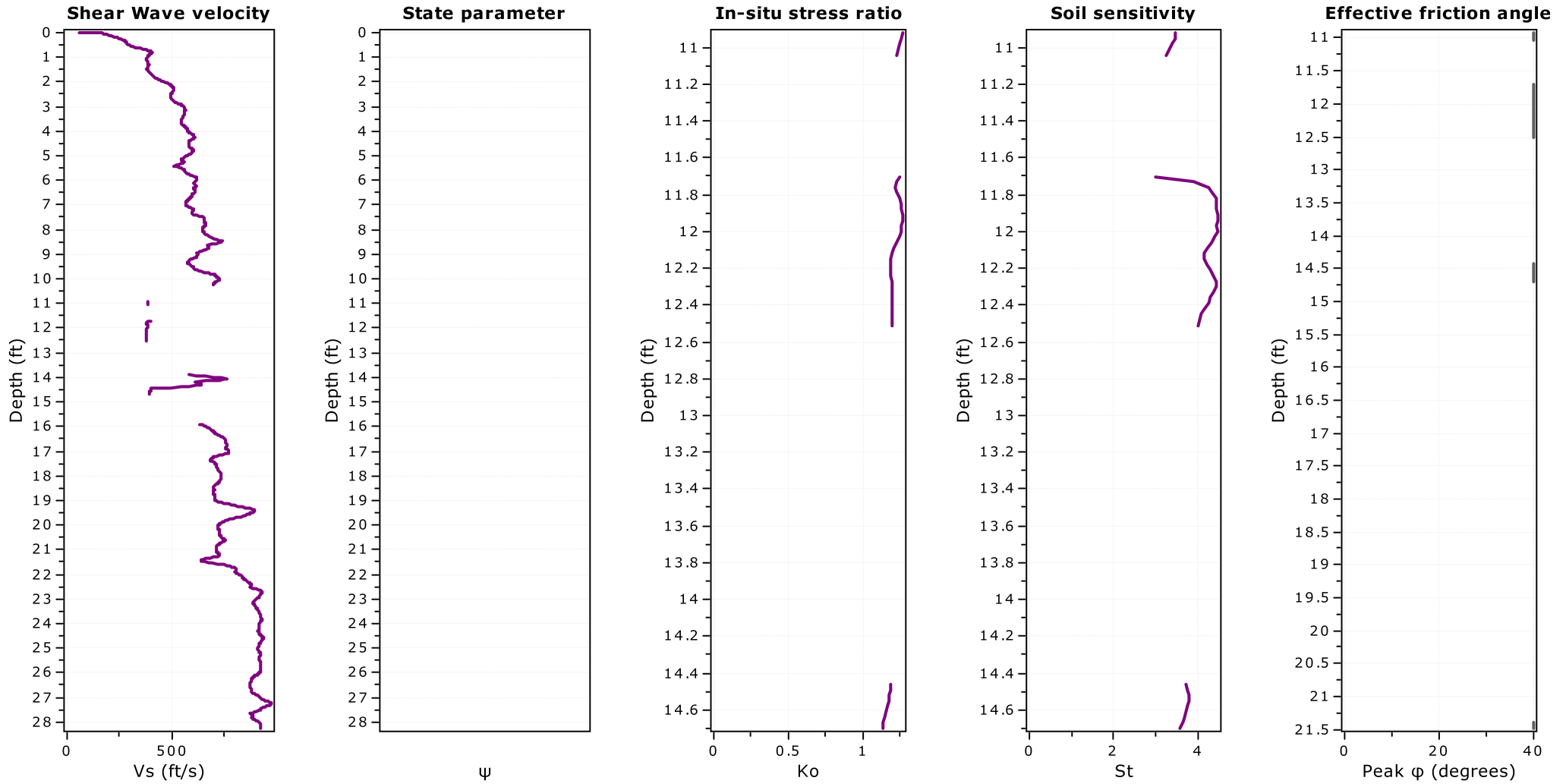
● Flat Dilatometer Test data



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Total depth: 28.26 ft, Date: 9/25/2025  
Est. GWL: 5.50 ft  
Cone Operator: Discovery Drilling, LLC



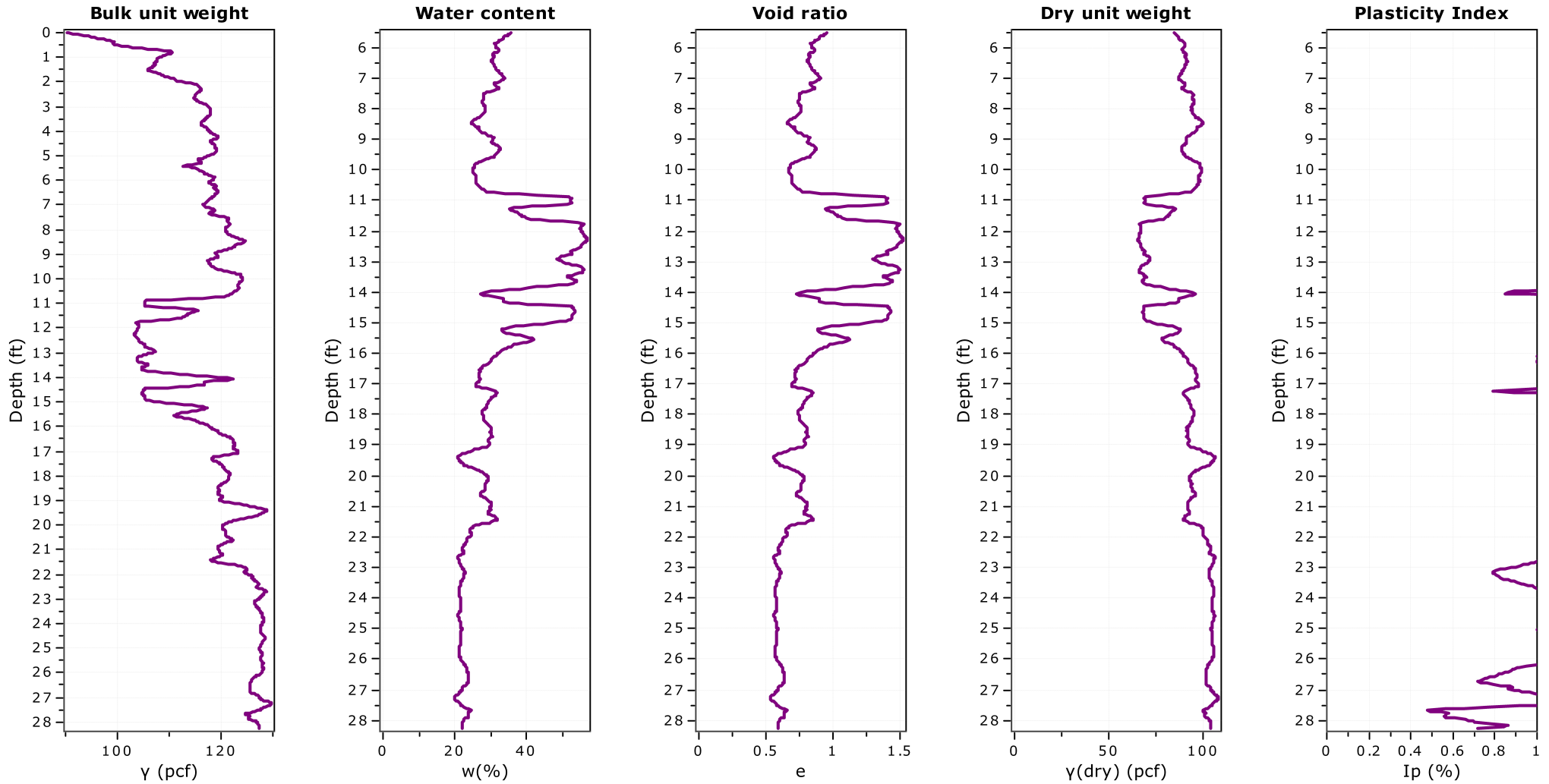
**Calculation parameters**  
Soil Sensitivity factor,  $N_s$ : 7.00



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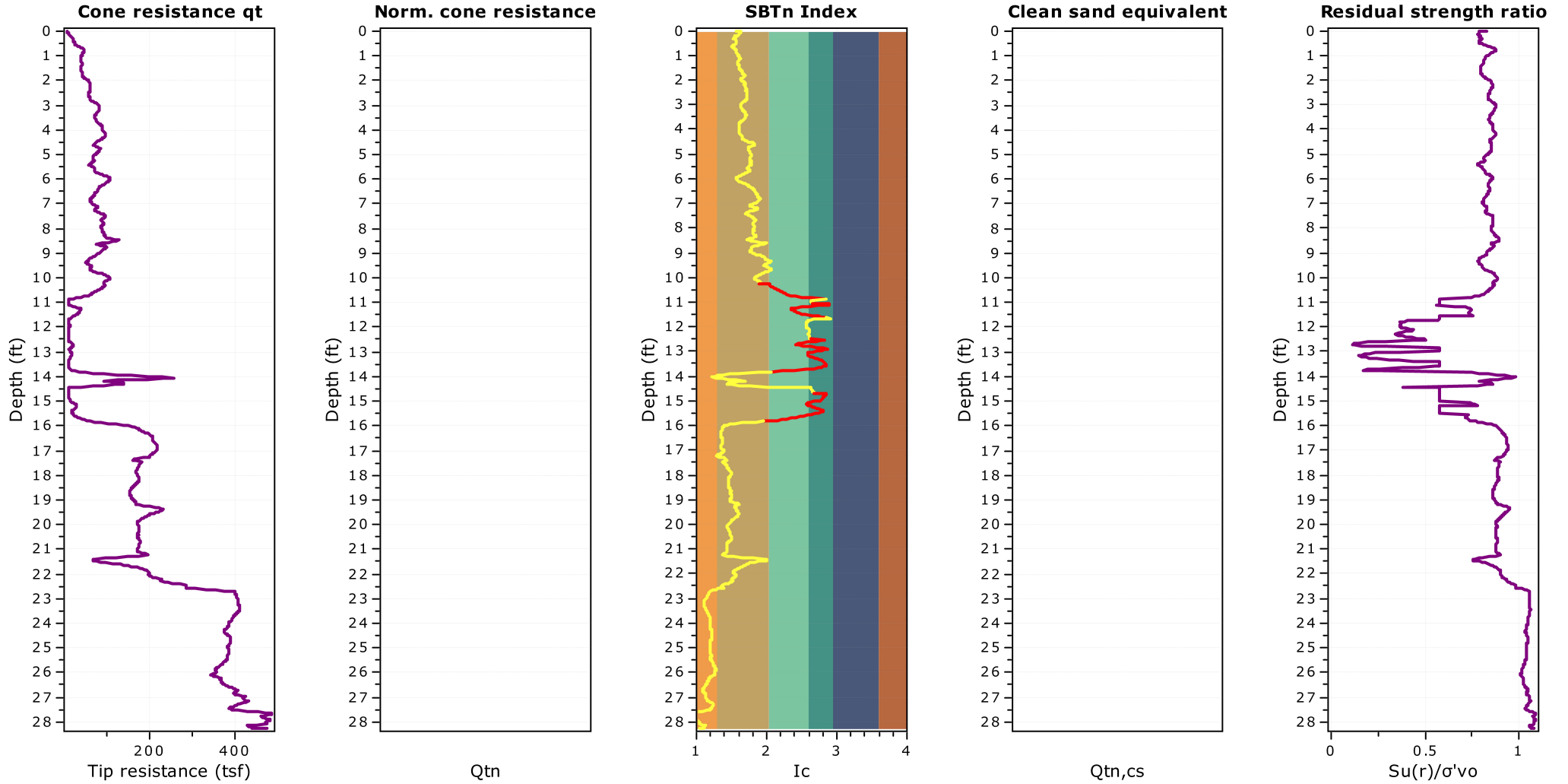




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Total depth: 28.26 ft, Date: 9/25/2025  
Est. GWL: 5.50 ft  
Cone Operator: Discovery Drilling, LLC



Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

**:: Unit Weight,  $g$  (kN/m<sup>3</sup>) ::**

$$g = g_w \cdot \left( 0.27 \cdot \log(R_f) + 0.36 \cdot \log\left(\frac{q_t}{p_a}\right) + 1.236 \right)$$

where  $g_w$  = water unit weight

**:: Permeability,  $k$  (m/s) ::**

$$I_c < 3.27 \text{ and } I_c > 1.00 \text{ then } k = 10^{0.952-3.04 \cdot I_c}$$

$$I_c \leq 4.00 \text{ and } I_c > 3.27 \text{ then } k = 10^{-4.52-1.37 \cdot I_c}$$

**::  $N_{60PT}$  (blows per 30 cm) ::**

$$N_{60} = \left( \frac{q_c}{p_a} \right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

**:: Young's Modulus,  $E_s$  (MPa) ::**

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to  $I_c < I_{c\_cutoff}$ )

**:: Relative Density,  $D_r$  (%) ::**

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}} \quad \text{(applicable only to SBT}_n\text{: 5, 6, 7 and 8 or } I_c < I_{c\_cutoff}\text{)}$$

**:: State Parameter,  $\psi$  ::**

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

**:: Drained Friction Angle,  $\phi$  (°) ::**

$$\phi = 29.5^\circ \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable only to SBT<sub>n</sub>: 5, 6, 7 and 8 or  $I_c < I_{c\_cutoff}$ )

**:: 1-D constrained modulus,  $M$  (MPa) ::**

If  $I_c > 2.20$   
 $\alpha = 14$  for  $Q_{tn} > 14$   
 $\alpha = Q_{tn}$  for  $Q_{tn} \leq 14$   
 $M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If  $I_c \geq 2.20$

**:: Small strain shear Modulus,  $G_0$  (MPa) ::**

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

**:: Shear Wave Velocity,  $V_s$  (m/s) ::**

$$V_s = \left( \frac{G_0}{\rho} \right)^{0.50}$$

**:: Undrained peak shear strength,  $S_u$  (kPa) ::**

$$N_{kt} = 10.50 + 7 \cdot \log(F_r) \text{ or user defined}$$

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

**:: Remolded undrained shear strength,  $S_u(rem)$  (kPa) ::**

$$S_{u(rem)} = f_s \quad \text{(applicable only to SBT}_n\text{: 1, 2, 3, 4 and 9 or } I_c > I_{c\_cutoff}\text{)}$$

**:: Overconsolidation Ratio, OCR ::**

$$k_{OCR} = \left[ \frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 + 7 \cdot \log(F_r))} \right]^{1.25} \text{ or user defined}$$

$$OCR = k_{OCR} \cdot Q_{tn}$$

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

**:: In situ Stress Ratio,  $K_0$  ::**

$$K_0 = (1 - \sin \phi') \cdot OCR^{\sin \phi'}$$

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

**:: Soil Sensitivity,  $S_t$  ::**

$$S_t = \frac{N_s}{F_r}$$

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

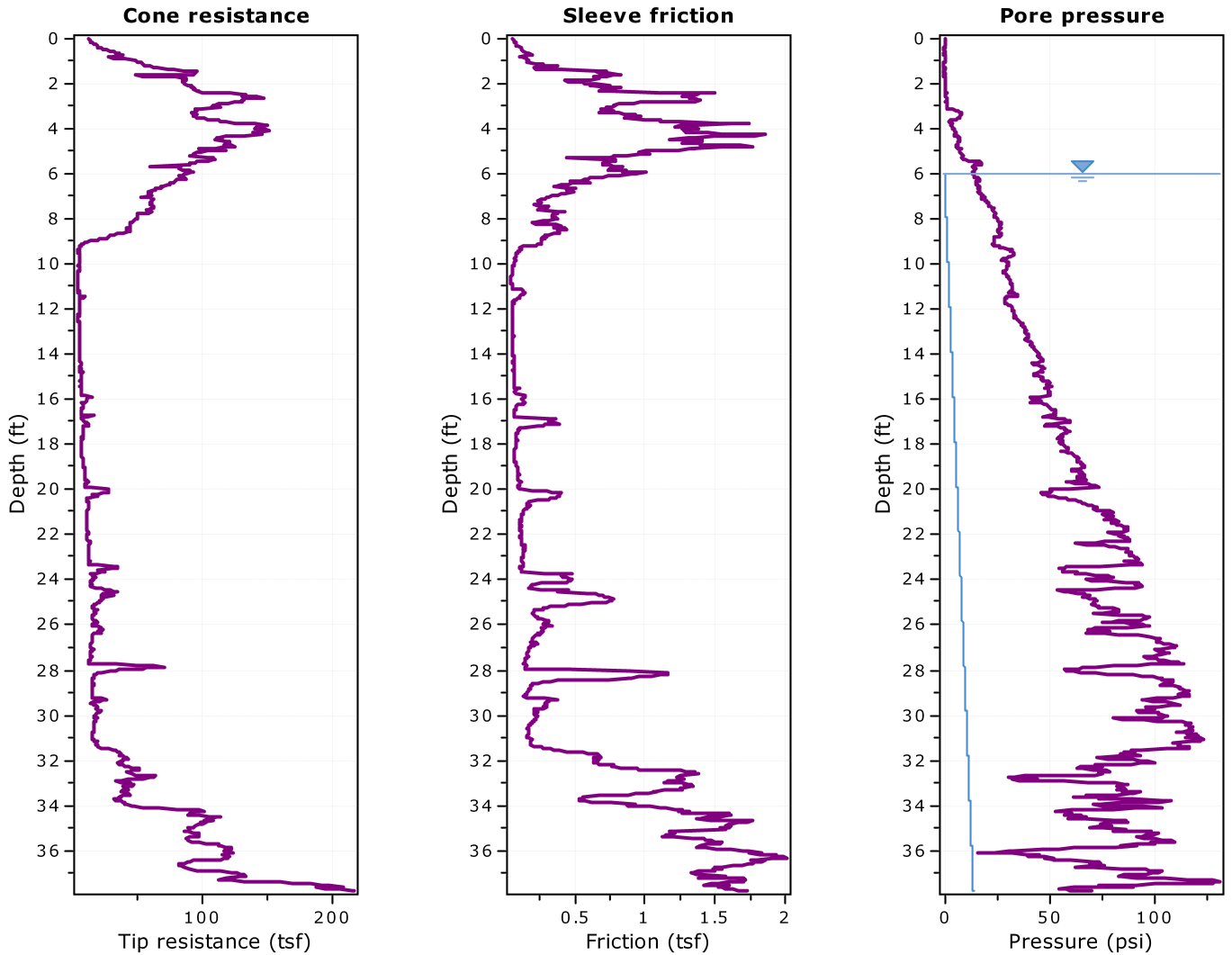
**:: Peak Friction Angle,  $\phi'$  (°) ::**

$$\phi' = 29.5^\circ \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for  $0.10 < B_q < 1.00$ )

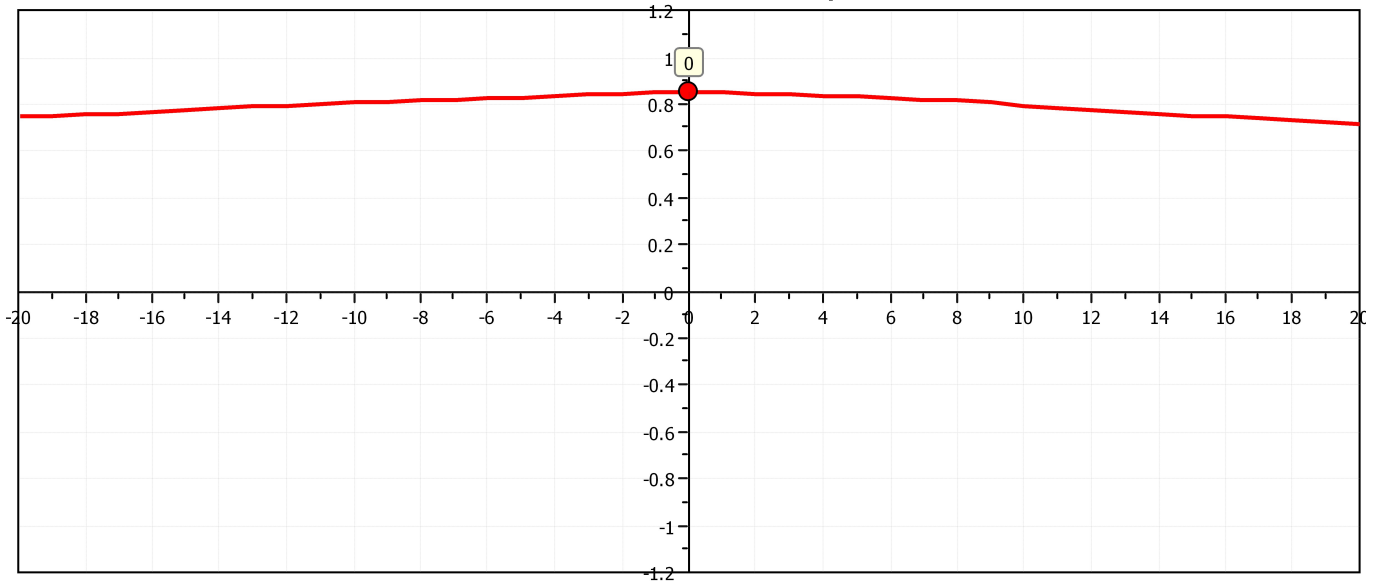
**References**

- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5<sup>th</sup> Edition, November 2012
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)
- N Barounis, J Philpot, Estimation of in-situ water content, void ratio, dry unit weight and porosity using CPT for saturated sands, Proc. 20th NZGS Geotechnical Symposium



The plot below presents the cross correlation coefficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).

Cross correlation between qc & fs





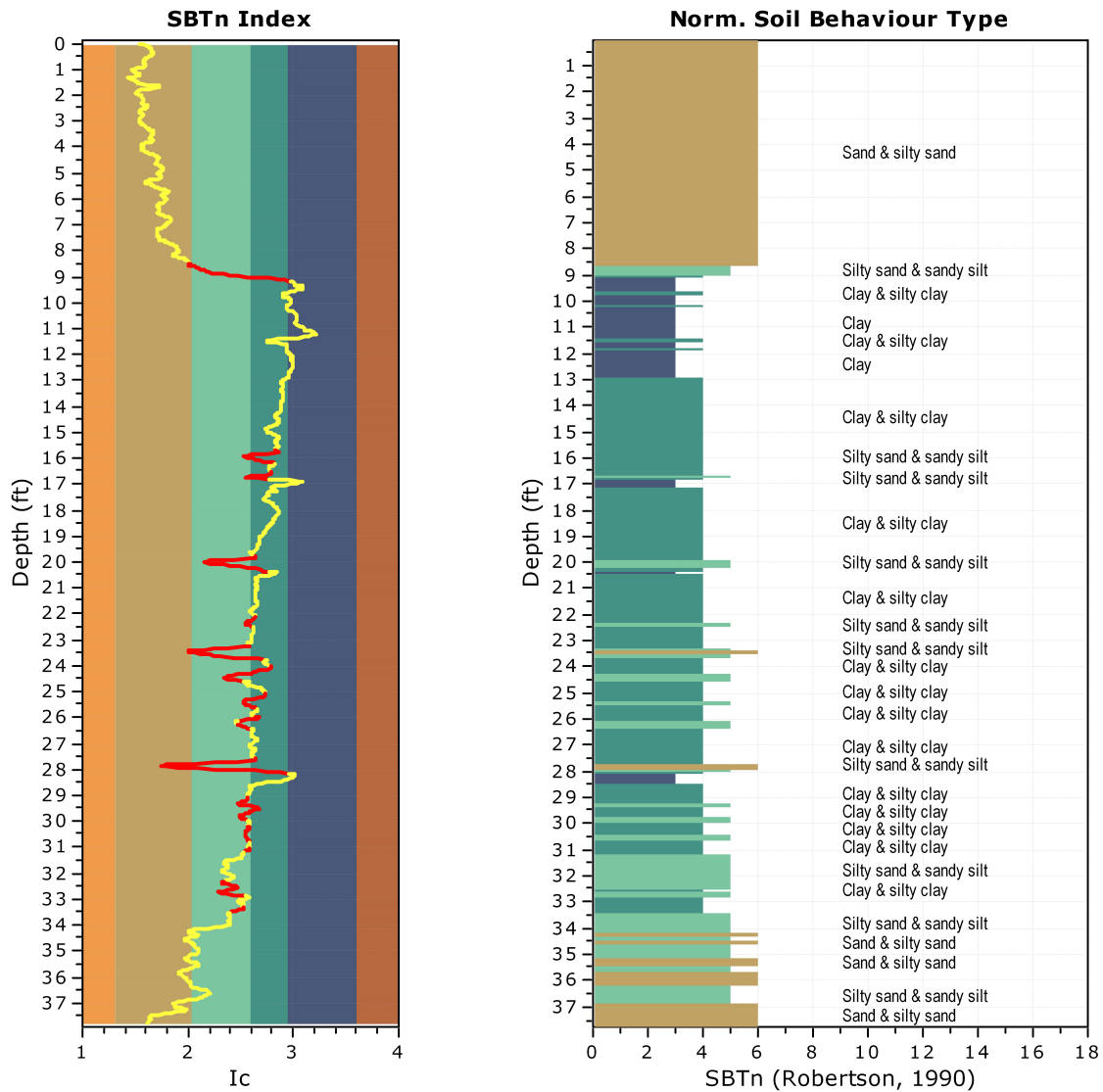
## TRANSITION LAYER DETECTION ALGORITHM REPORT

### Summary Details & Plots

#### Short description

The software will delete data when the cone is in transition from either clay to sand or vice-versa. To do this the software requires a range of  $I_c$  values over which the transition will be defined (typically somewhere between  $1.80 < I_c < 3.0$ ) and a rate of change of  $I_c$ . Transitions typically occur when the rate of change of  $I_c$  is fast (i.e.  $\Delta I_c$  is small).

The  $SBT_n$  plot below, displays in red the detected transition layers based on the parameters listed below the graphs.



#### Transition layer algorithm properties

$I_c$  minimum check value: 1.70  
 $I_c$  maximum check value: 3.00  
 $I_c$  change ratio value: 0.0010  
 Minimum number of points in layer: 4

#### General statistics

Total points in CPT file: 1259  
 Total points excluded: 280  
 Exclusion percentage: 22.24%  
 Number of layers detected: 30

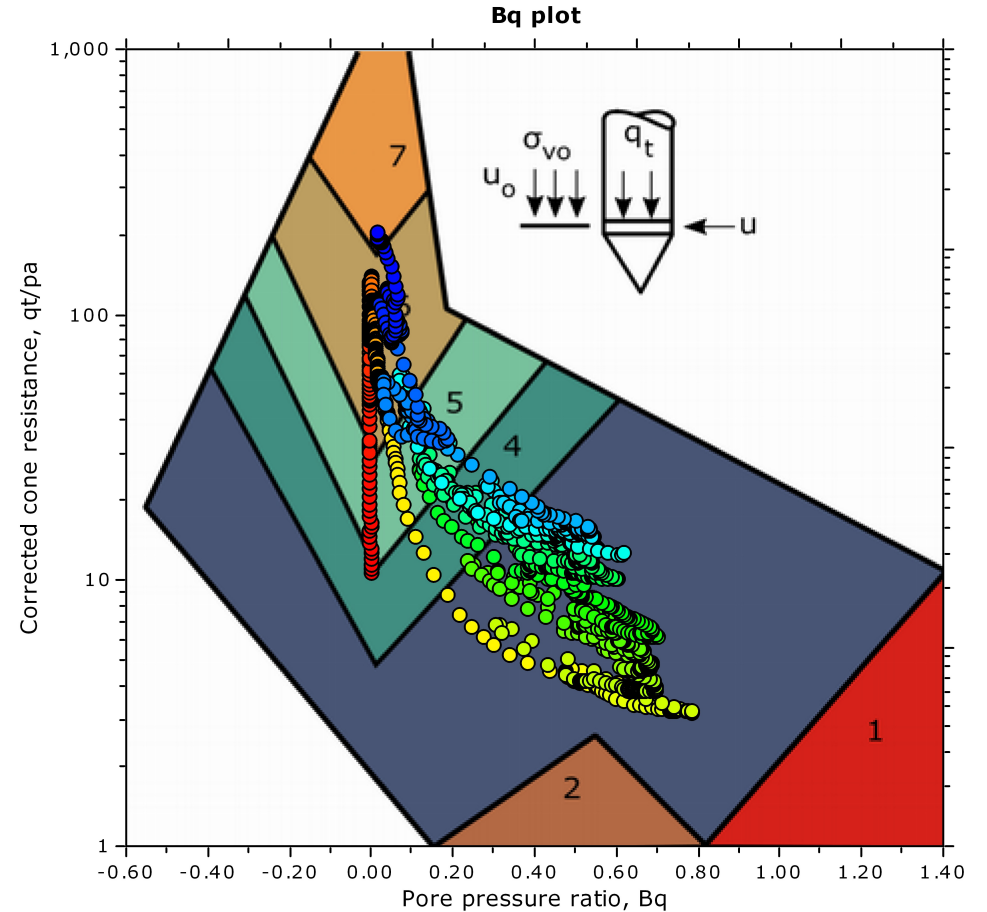
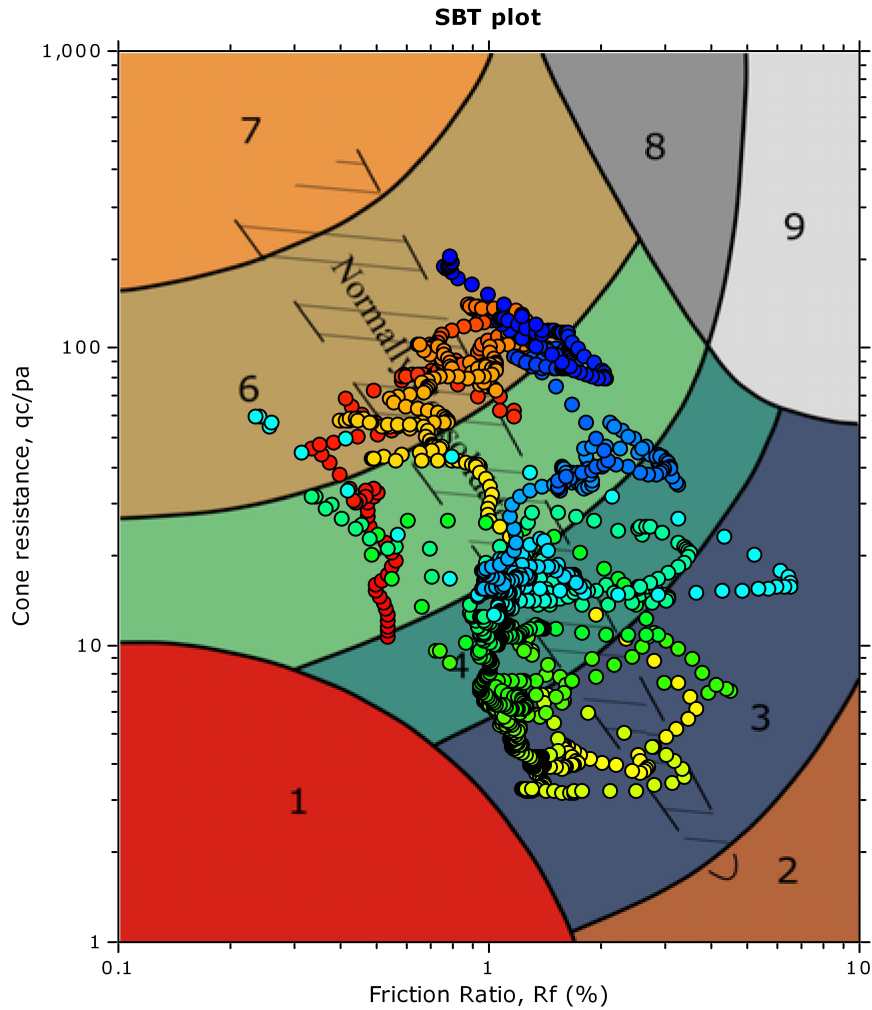
Transition layer No	Number of points	Depth	SBT <sub>n</sub> number	SBT <sub>n</sub> description
Transition layer 1	24	Start depth: 8.52 (ft)	6	Sand & silty sand
		End depth: 9.21 (ft)	3	Clay
Transition layer 2	7	Start depth: 15.75 (ft)	4	Clay & silty clay
		End depth: 15.93 (ft)	5	Silty sand & sandy silt
Transition layer 3	11	Start depth: 15.93 (ft)	5	Silty sand & sandy silt
		End depth: 16.23 (ft)	4	Clay & silty clay
Transition layer 4	6	Start depth: 16.56 (ft)	4	Clay & silty clay
		End depth: 16.71 (ft)	5	Silty sand & sandy silt
Transition layer 5	5	Start depth: 16.71 (ft)	5	Silty sand & sandy silt
		End depth: 16.83 (ft)	3	Clay
Transition layer 6	7	Start depth: 19.83 (ft)	4	Clay & silty clay
		End depth: 20.01 (ft)	5	Silty sand & sandy silt
Transition layer 7	14	Start depth: 20.01 (ft)	5	Silty sand & sandy silt
		End depth: 20.40 (ft)	3	Clay
Transition layer 8	9	Start depth: 22.11 (ft)	4	Clay & silty clay
		End depth: 22.35 (ft)	5	Silty sand & sandy silt
Transition layer 9	7	Start depth: 22.35 (ft)	5	Silty sand & sandy silt
		End depth: 22.53 (ft)	4	Clay & silty clay
Transition layer 10	8	Start depth: 23.25 (ft)	4	Clay & silty clay
		End depth: 23.46 (ft)	6	Sand & silty sand
Transition layer 11	12	Start depth: 23.46 (ft)	6	Sand & silty sand
		End depth: 23.79 (ft)	4	Clay & silty clay
Transition layer 12	15	Start depth: 24.06 (ft)	4	Clay & silty clay
		End depth: 24.48 (ft)	5	Silty sand & sandy silt
Transition layer 13	6	Start depth: 24.48 (ft)	5	Silty sand & sandy silt
		End depth: 24.63 (ft)	4	Clay & silty clay
Transition layer 14	10	Start depth: 25.11 (ft)	4	Clay & silty clay
		End depth: 25.38 (ft)	5	Silty sand & sandy silt
Transition layer 15	12	Start depth: 25.38 (ft)	5	Silty sand & sandy silt
		End depth: 25.71 (ft)	4	Clay & silty clay
Transition layer 16	7	Start depth: 25.98 (ft)	4	Clay & silty clay
		End depth: 26.16 (ft)	5	Silty sand & sandy silt
Transition layer 17	7	Start depth: 26.28 (ft)	5	Silty sand & sandy silt
		End depth: 26.46 (ft)	4	Clay & silty clay
Transition layer 18	10	Start depth: 27.60 (ft)	4	Clay & silty clay
		End depth: 27.87 (ft)	6	Sand & silty sand
Transition layer 19	11	Start depth: 27.87 (ft)	6	Sand & silty sand
		End depth: 28.17 (ft)	3	Clay
Transition layer 20	7	Start depth: 29.13 (ft)	4	Clay & silty clay
		End depth: 29.31 (ft)	5	Silty sand & sandy silt
Transition layer 21	7	Start depth: 29.31 (ft)	5	Silty sand & sandy silt
		End depth: 29.49 (ft)	4	Clay & silty clay
Transition layer 22	11	Start depth: 29.49 (ft)	4	Clay & silty clay
		End depth: 29.79 (ft)	5	Silty sand & sandy silt
Transition layer 23	8	Start depth: 29.79 (ft)	5	Silty sand & sandy silt
		End depth: 30.00 (ft)	4	Clay & silty clay

Transition layer No	Number of points	Depth	SBT <sub>n</sub> number	SBT <sub>n</sub> description
Transition layer 24	9	Start depth: 30.24 (ft)	4	Clay & silty clay
		End depth: 30.48 (ft)	5	Silty sand & sandy silt
Transition layer 25	13	Start depth: 30.48 (ft)	5	Silty sand & sandy silt
		End depth: 30.84 (ft)	4	Clay & silty clay
Transition layer 26	7	Start depth: 31.05 (ft)	4	Clay & silty clay
		End depth: 31.23 (ft)	5	Silty sand & sandy silt
Transition layer 27	8	Start depth: 32.34 (ft)	5	Silty sand & sandy silt
		End depth: 32.55 (ft)	4	Clay & silty clay
Transition layer 28	7	Start depth: 32.55 (ft)	4	Clay & silty clay
		End depth: 32.73 (ft)	5	Silty sand & sandy silt
Transition layer 29	7	Start depth: 32.73 (ft)	5	Silty sand & sandy silt
		End depth: 32.91 (ft)	4	Clay & silty clay
Transition layer 30	8	Start depth: 33.36 (ft)	4	Clay & silty clay
		End depth: 33.57 (ft)	5	Silty sand & sandy silt

Start depth: Depth where the transition layer begins

End depth: Depth where the transition layer ends

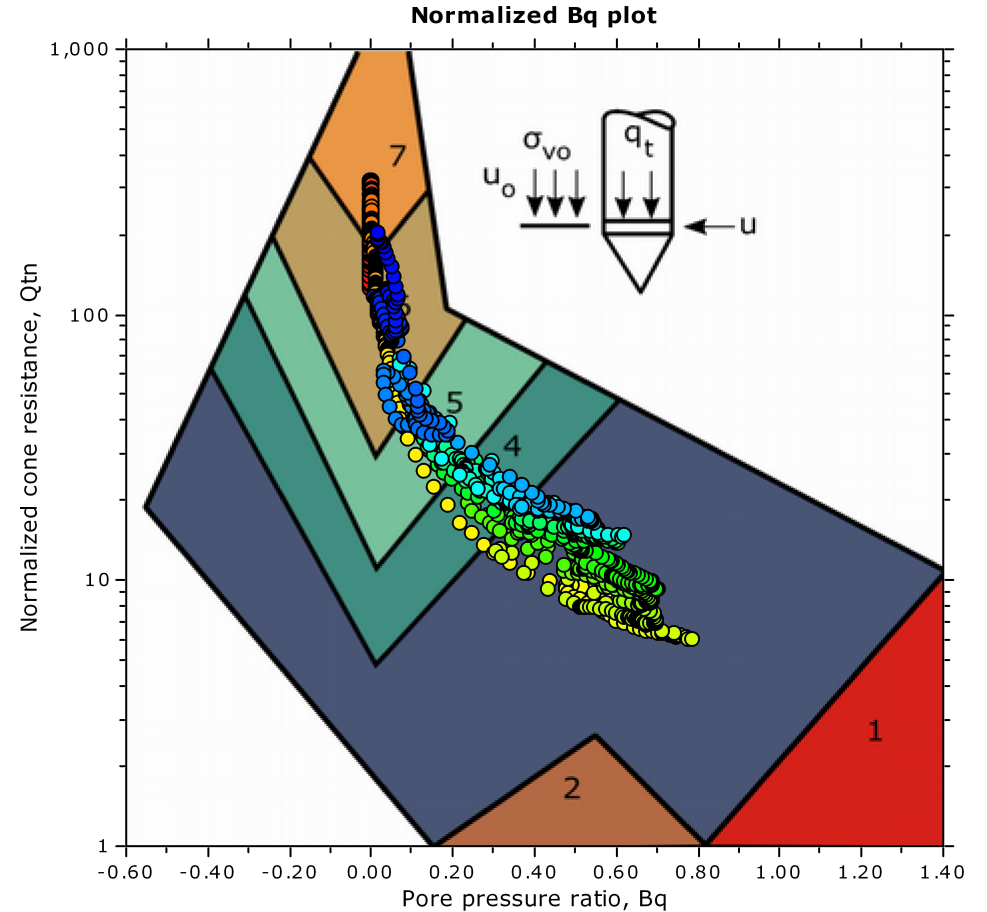
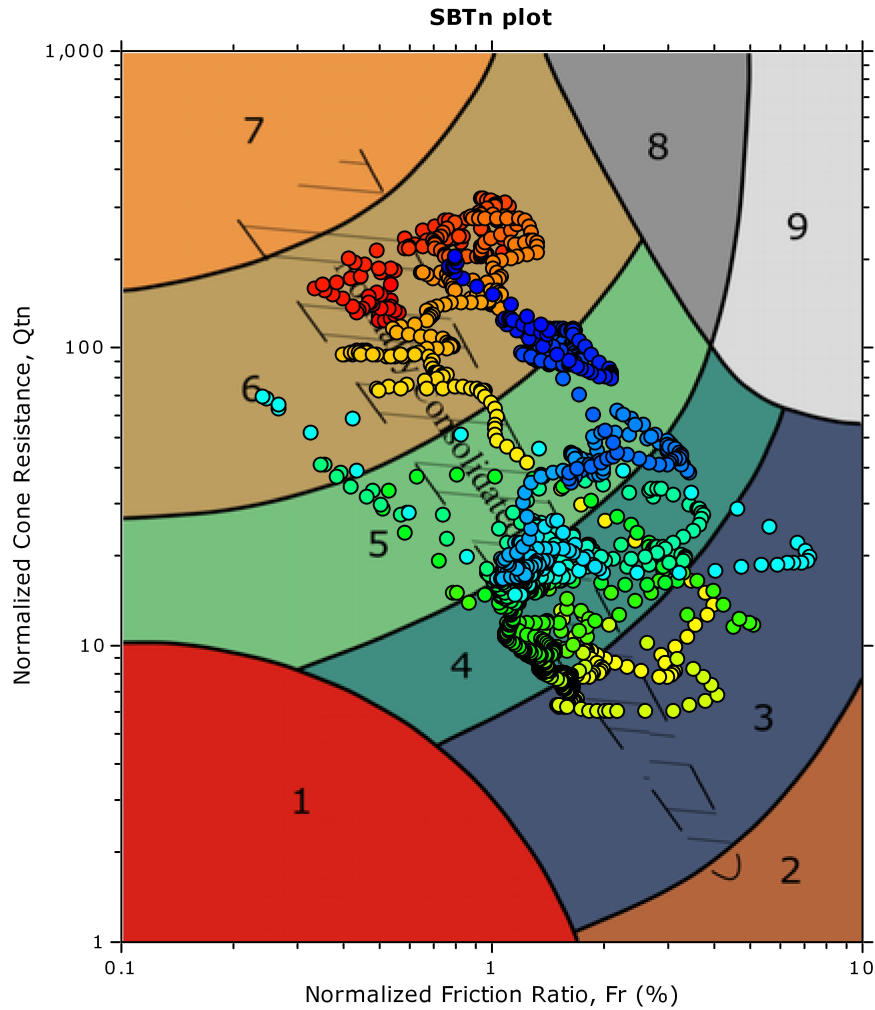
**SBT - Bq plots**



**SBT legend**

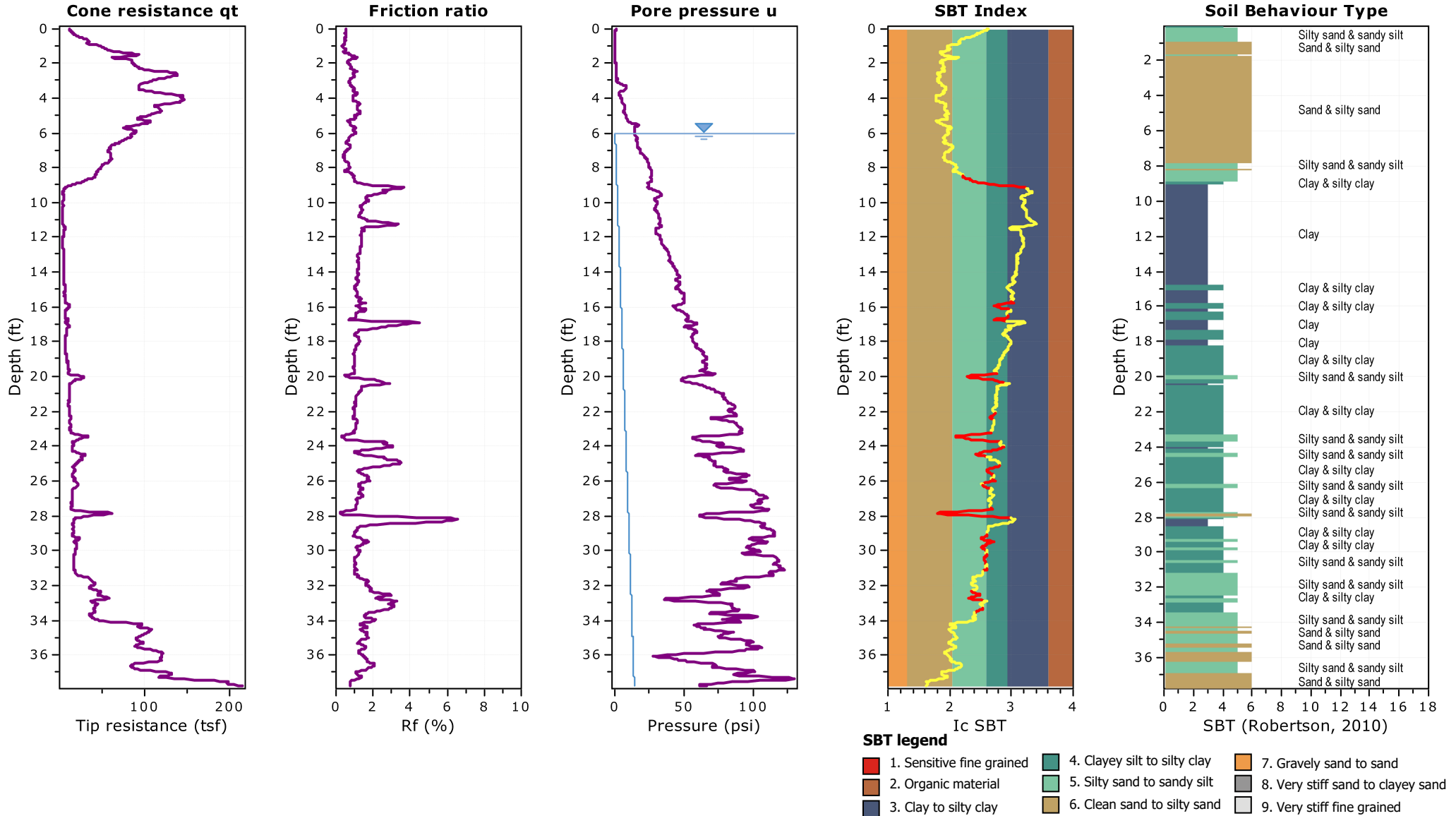
- |   |   |   |
|---|---|---|
| <span style="color: red;">■</span> 1. Sensitive fine grained  | <span style="color: teal;">■</span> 4. Clayey silt to silty clay      | <span style="color: orange;">■</span> 7. Gravelly sand to sand        |
| <span style="color: brown;">■</span> 2. Organic material      | <span style="color: lightgreen;">■</span> 5. Silty sand to sandy silt | <span style="color: grey;">■</span> 8. Very stiff sand to clayey sand |
| <span style="color: darkblue;">■</span> 3. Clay to silty clay | <span style="color: tan;">■</span> 6. Clean sand to silty sand        | <span style="color: lightgrey;">■</span> 9. Very stiff fine grained   |

**SBT - Bq plots (normalized)**



**SBTn legend**

- |  |   |   |
|--|---|---|
| <span style="color: red;">■</span> 1. Sensitive fine grained | <span style="color: teal;">■</span> 4. Clayey silt to silty clay      | <span style="color: orange;">■</span> 7. Gravelly sand to sand        |
| <span style="color: brown;">■</span> 2. Organic material     | <span style="color: lightgreen;">■</span> 5. Silty sand to sandy silt | <span style="color: grey;">■</span> 8. Very stiff sand to clayey sand |
| <span style="color: blue;">■</span> 3. Clay to silty clay    | <span style="color: tan;">■</span> 6. Clean sand to silty sand        | <span style="color: lightgrey;">■</span> 9. Very stiff fine grained   |

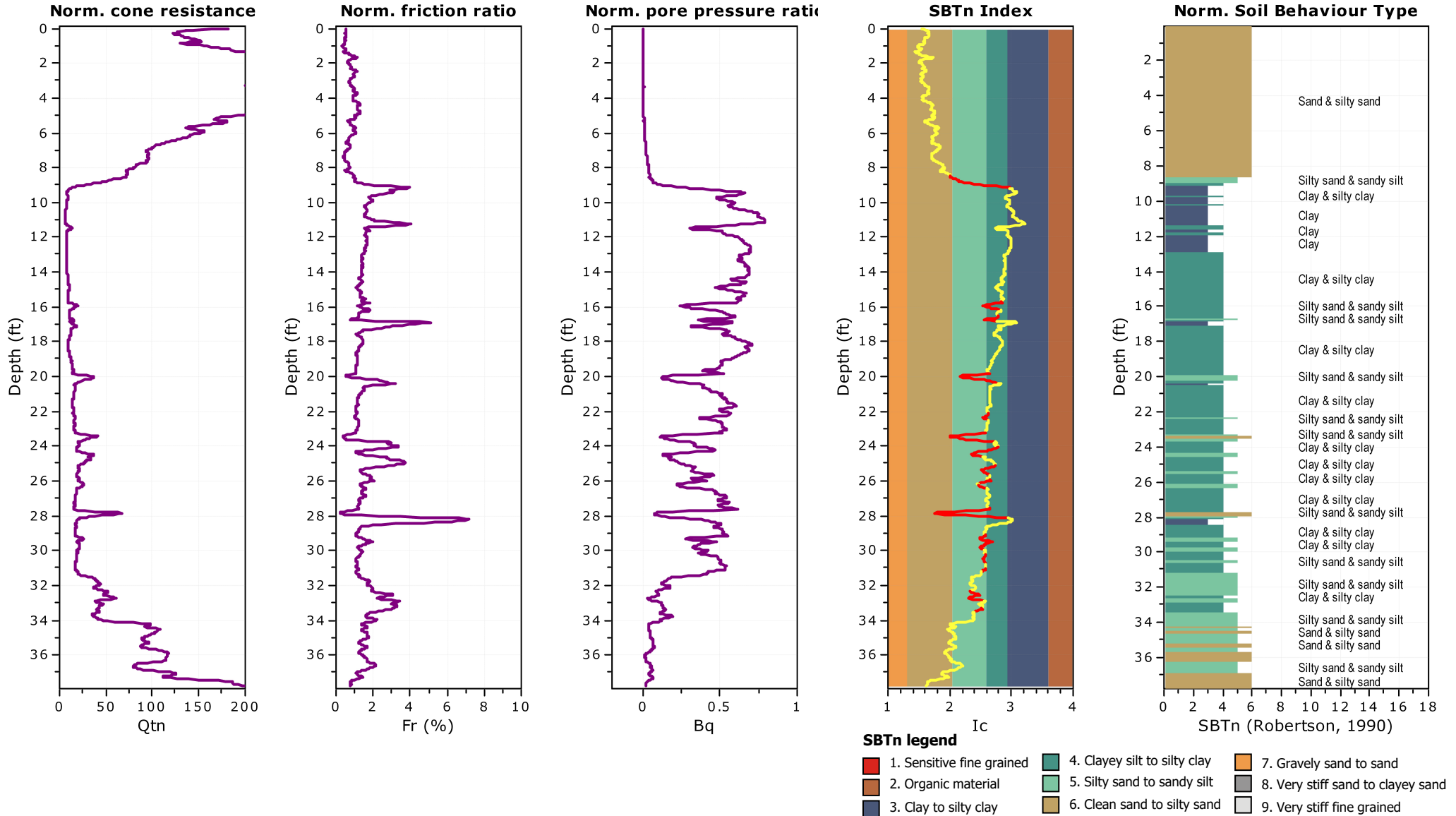


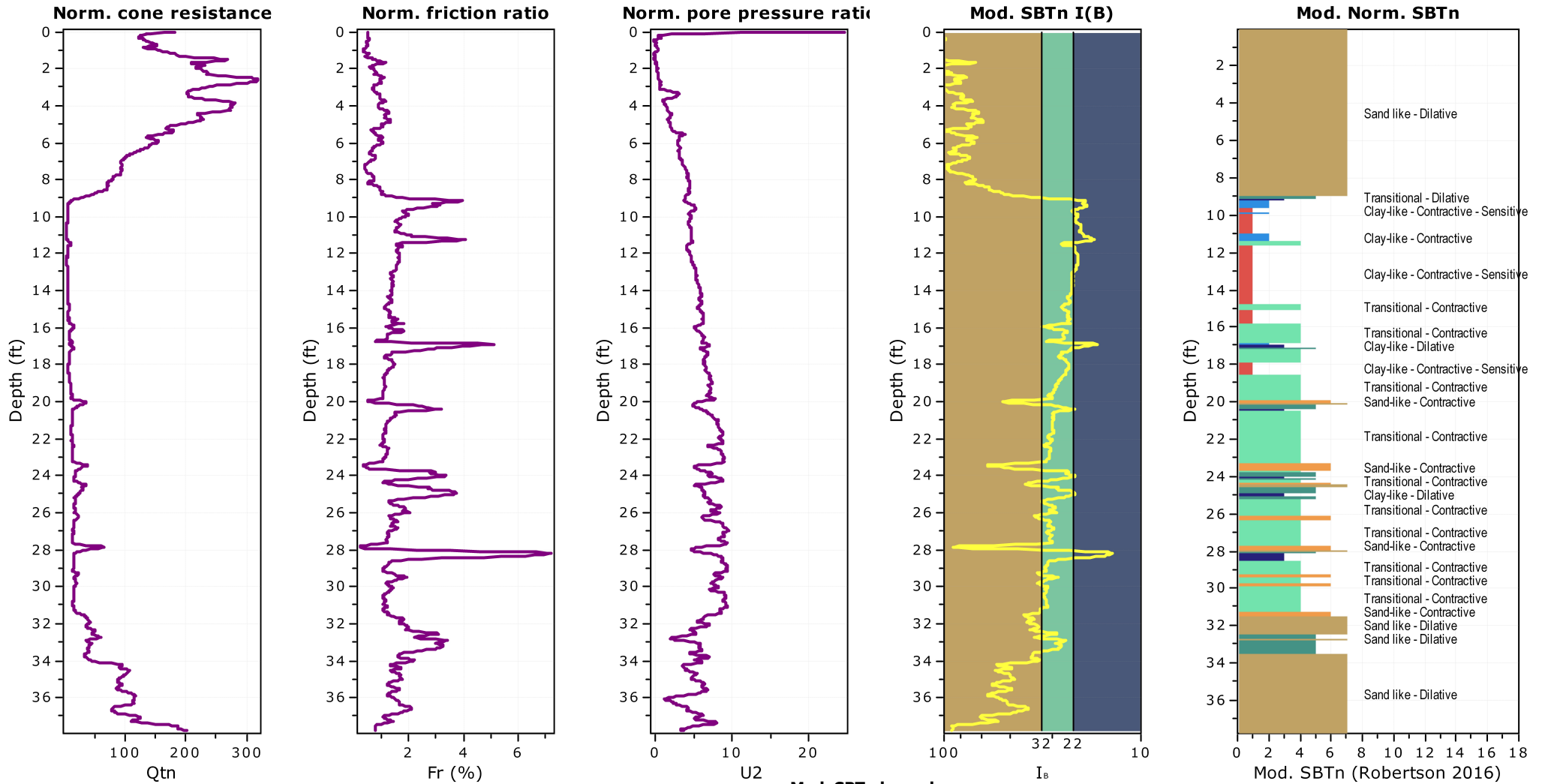


**PND Engineers, Inc**  
 1506 W. 36th Ave.  
 Anchorage, AK 99503

**Project: SEARHC Haines Clinic Site Investigation**  
**Location: Haines, Alaska**

**CPT: Average CPT - Housing**  
 Total depth: 37.77 ft, Date: 9/25/2025  
 Est. GWL: 6.00 ft  
 Cone Operator: Discovery Drilling, LLC

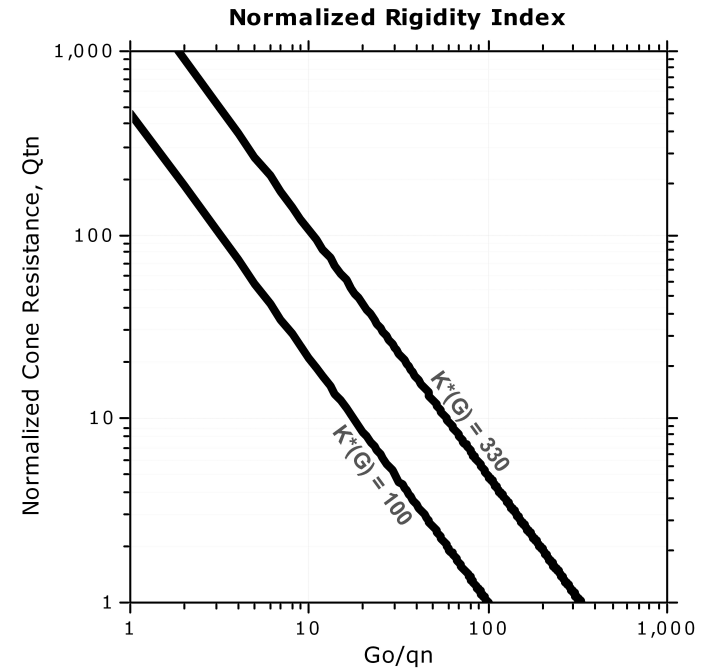
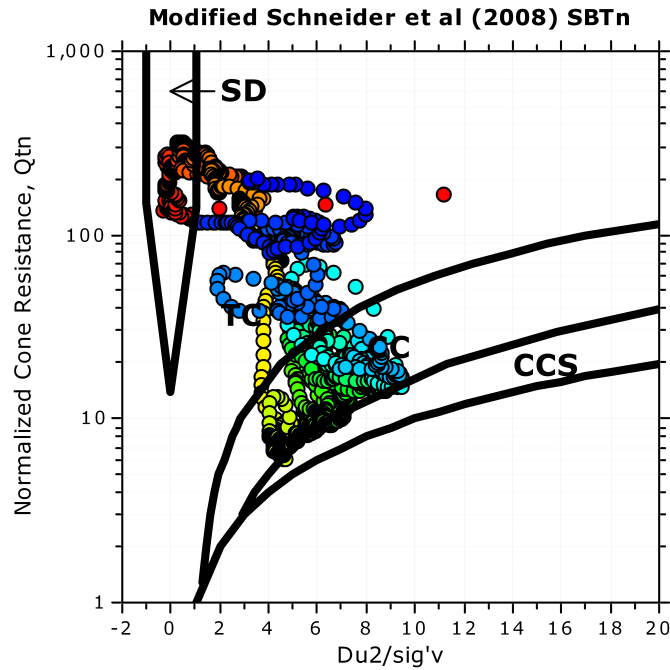
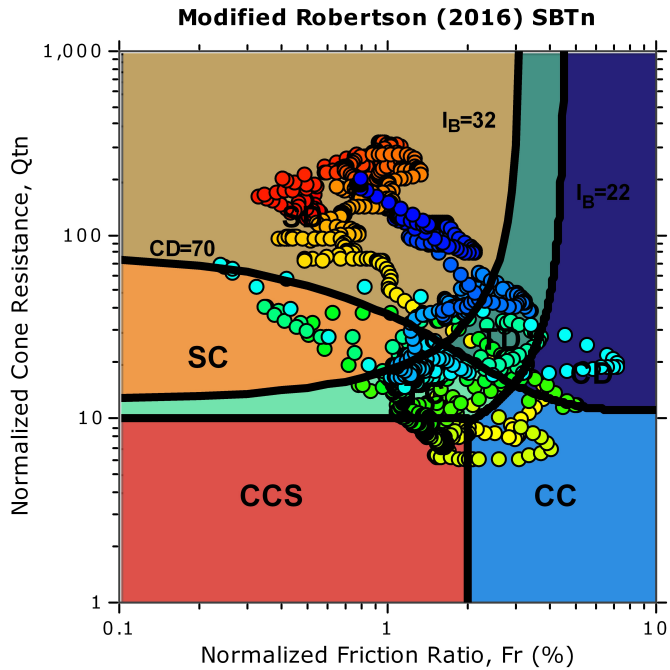




**Mod. SBTn legend**

- |  |   |  |
|--|---|--|
| <span style="color: red;">■</span> 1. CCS: ClayLike - Contractive, Sensitive | <span style="color: lightgreen;">■</span> 4. TC: Transitional - Contractive | <span style="color: brown;">■</span> 7. SD: Sand-like - Dilative |
| <span style="color: blue;">■</span> 2. CC: Clay-like - Contractive           | <span style="color: teal;">■</span> 5. TD: Transitional - Dilative          |  |
| <span style="color: darkblue;">■</span> 3. CD: Clay-Like: Dilative           | <span style="color: orange;">■</span> 6. SC: Sand-like - Contractive        |  |

**Updated SBTn plots**



- CCS: Clay-like - Contractive - Sensitive
- CC: Clay-like - Contractive
- CD: Clay-like - Dilative
- TC: Transitional - Contractive
- TD: Transitional - Dilative
- SC: Sand-like - Contractive
- SD: Sand-like - Dilative

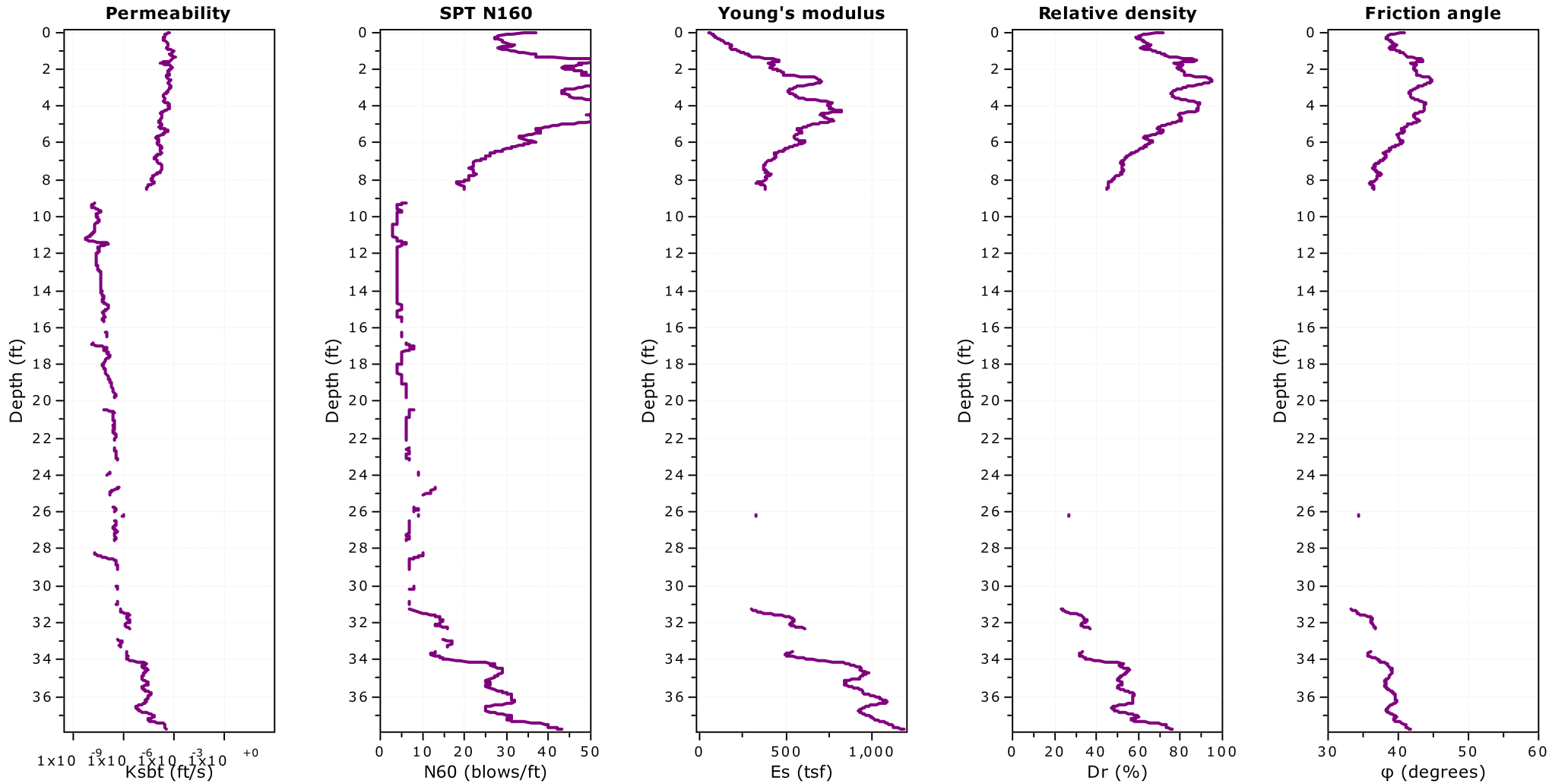
$K^*(G) > 330$ : Soils with significant microstructure (e.g. age/cementation)



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**Calculation parameters**

Permeability: Based on  $SBT_n$

SPT  $N_{60}$ : Based on  $I_c$  and  $q_t$

Young's modulus: Based on variable alpha using  $I_c$  (Robertson, 2009)

Relative density constant,  $C_{Dr}$ : 350.0

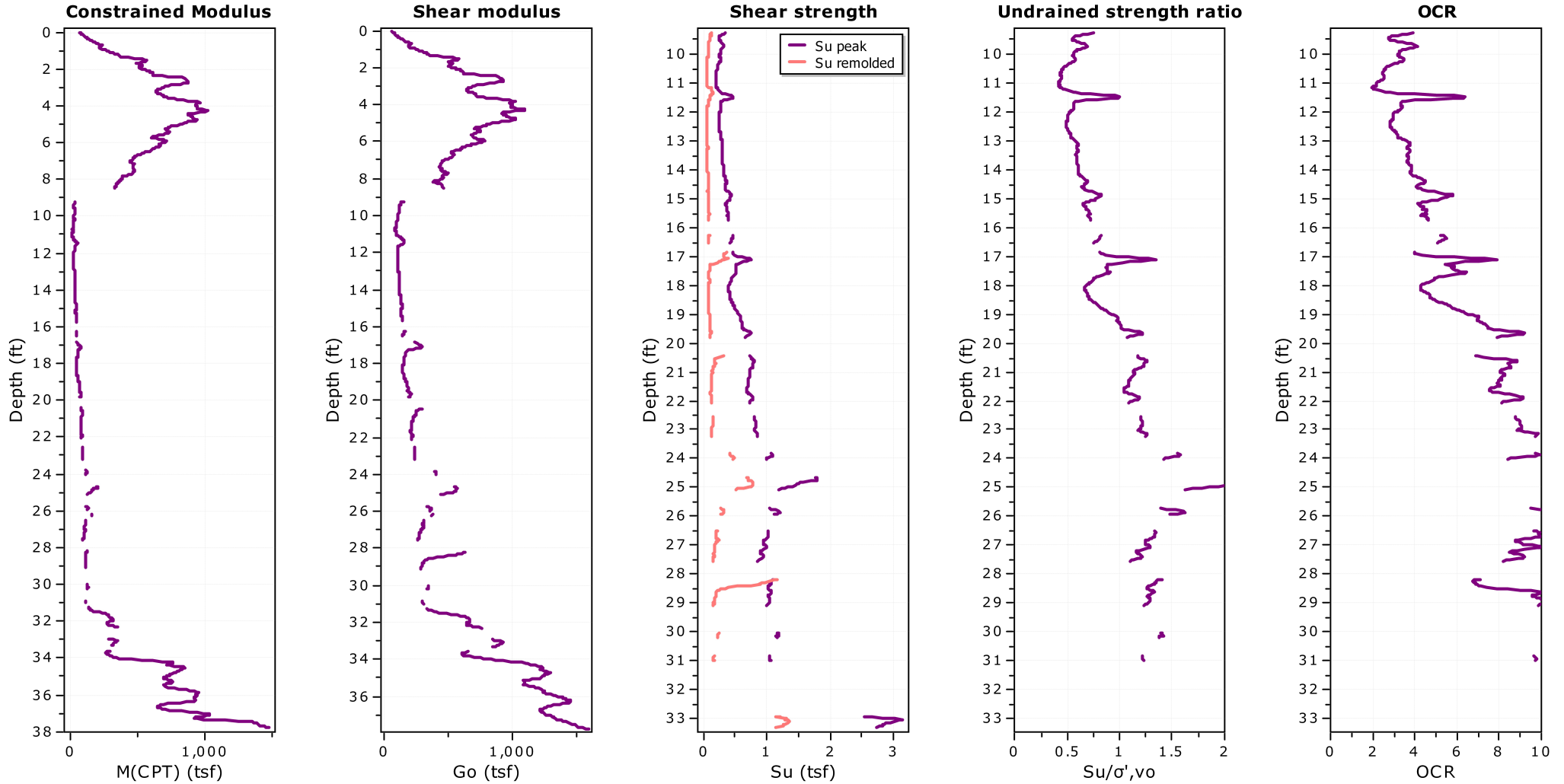
Phi: Based on Kulhawy & Mayne (1990)



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 Cone Operator: Discovery Drilling, LLC



**Calculation parameters**

Constrained modulus: Based on variable  $\alpha$  using  $I_c$  and  $Q_{tn}$  (Robertson, 2009)

Go: Based on variable  $\alpha$  using  $I_c$  (Robertson, 2009)

Undrained shear strength cone factor for clays,  $N_{kt}$ : 14

OCR factor for clays,  $N_{kt}$ : Auto

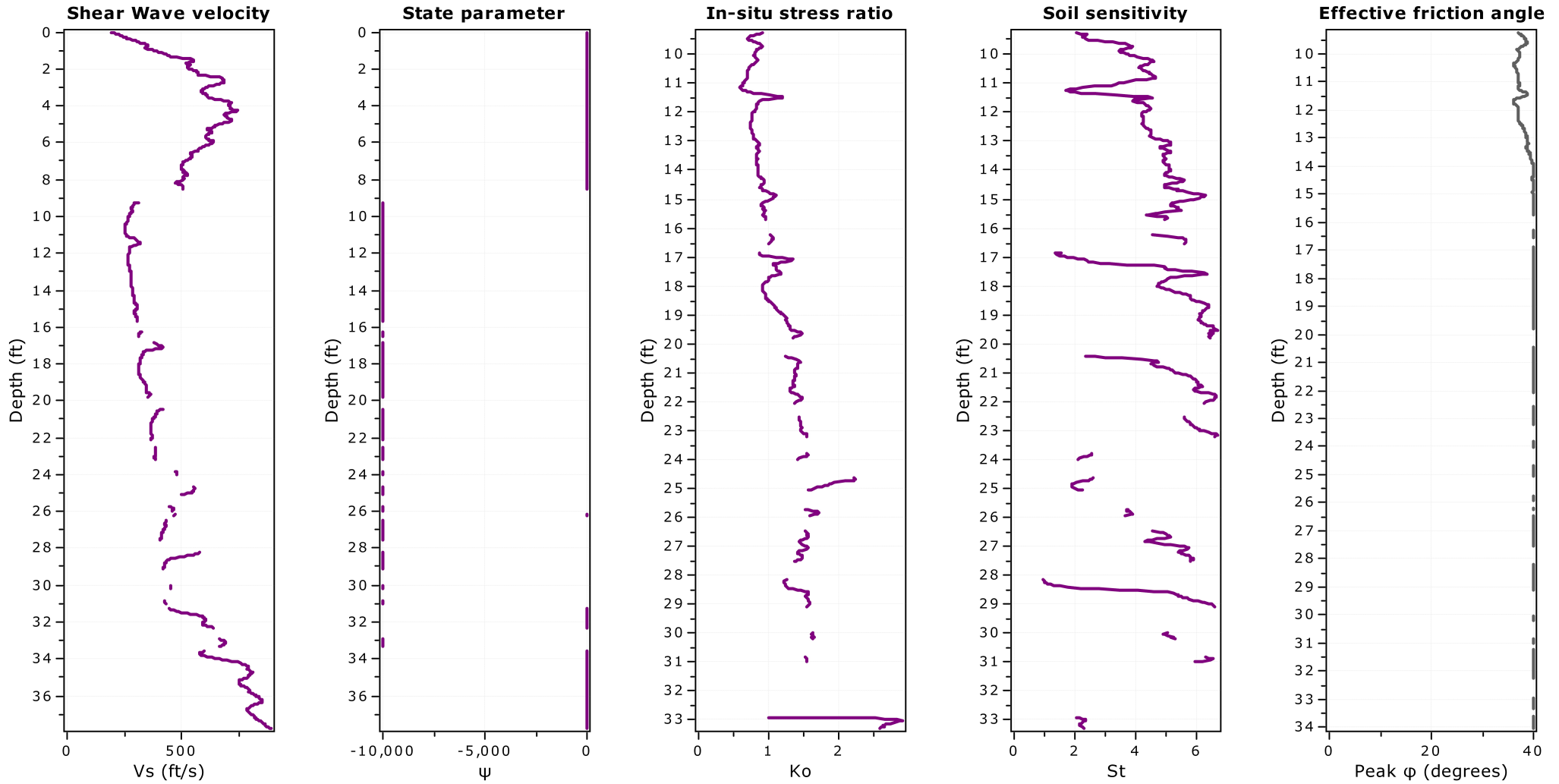
● Flat Dilatometer Test data



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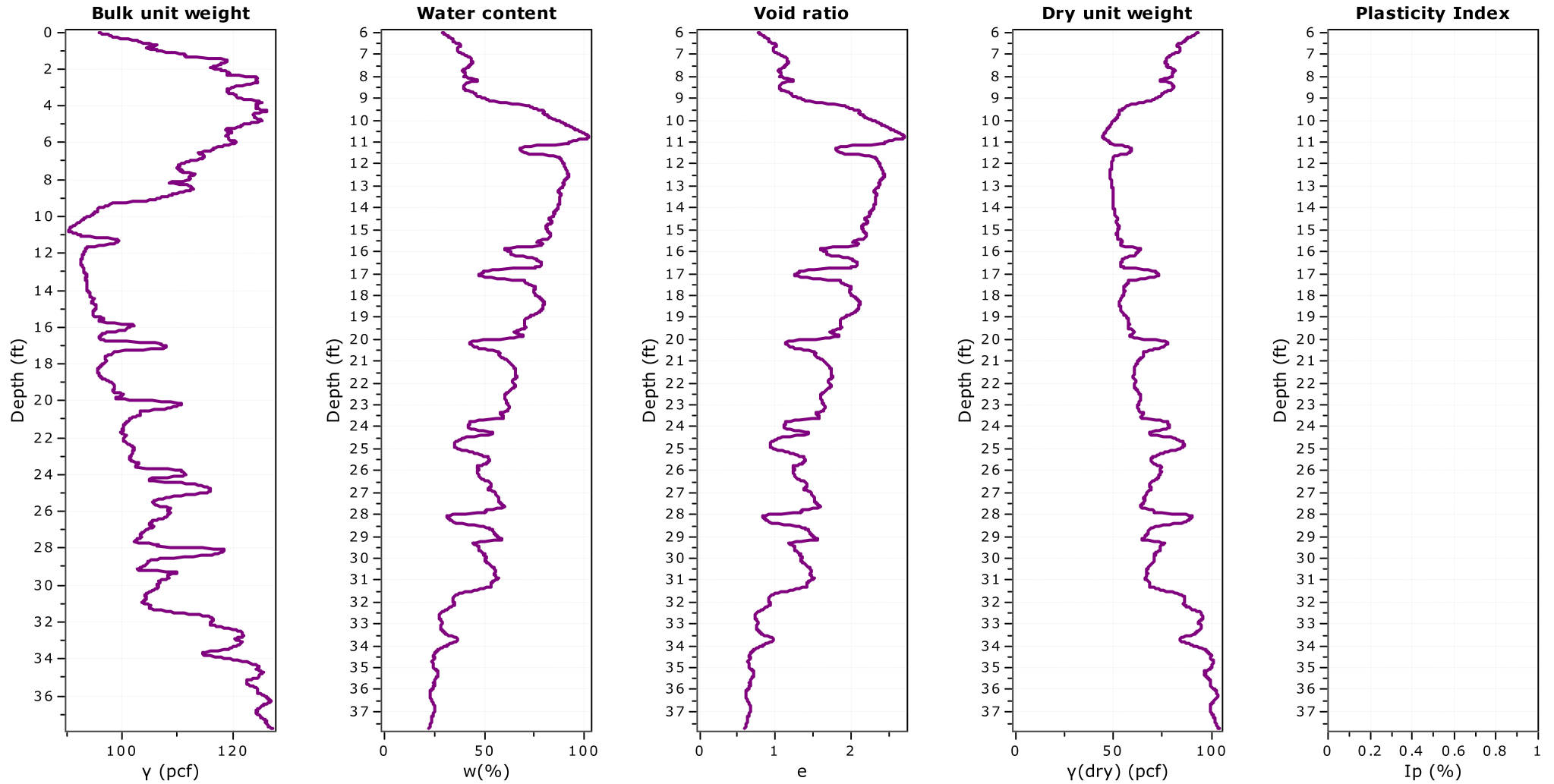
**Calculation parameters**  
Soil Sensitivity factor,  $N_s$ : 7.00



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Cone Operator: Discovery Drilling, LLC

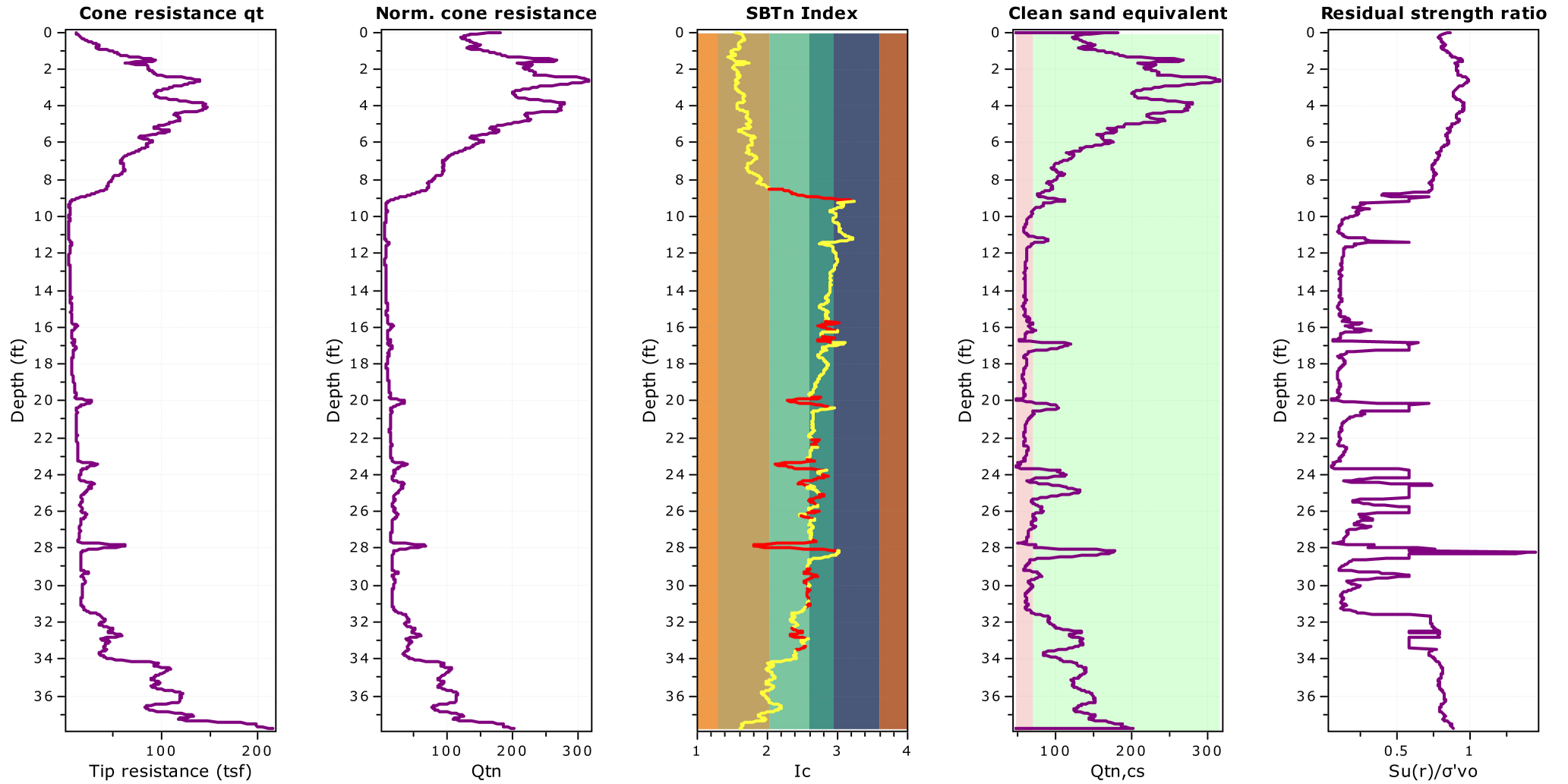




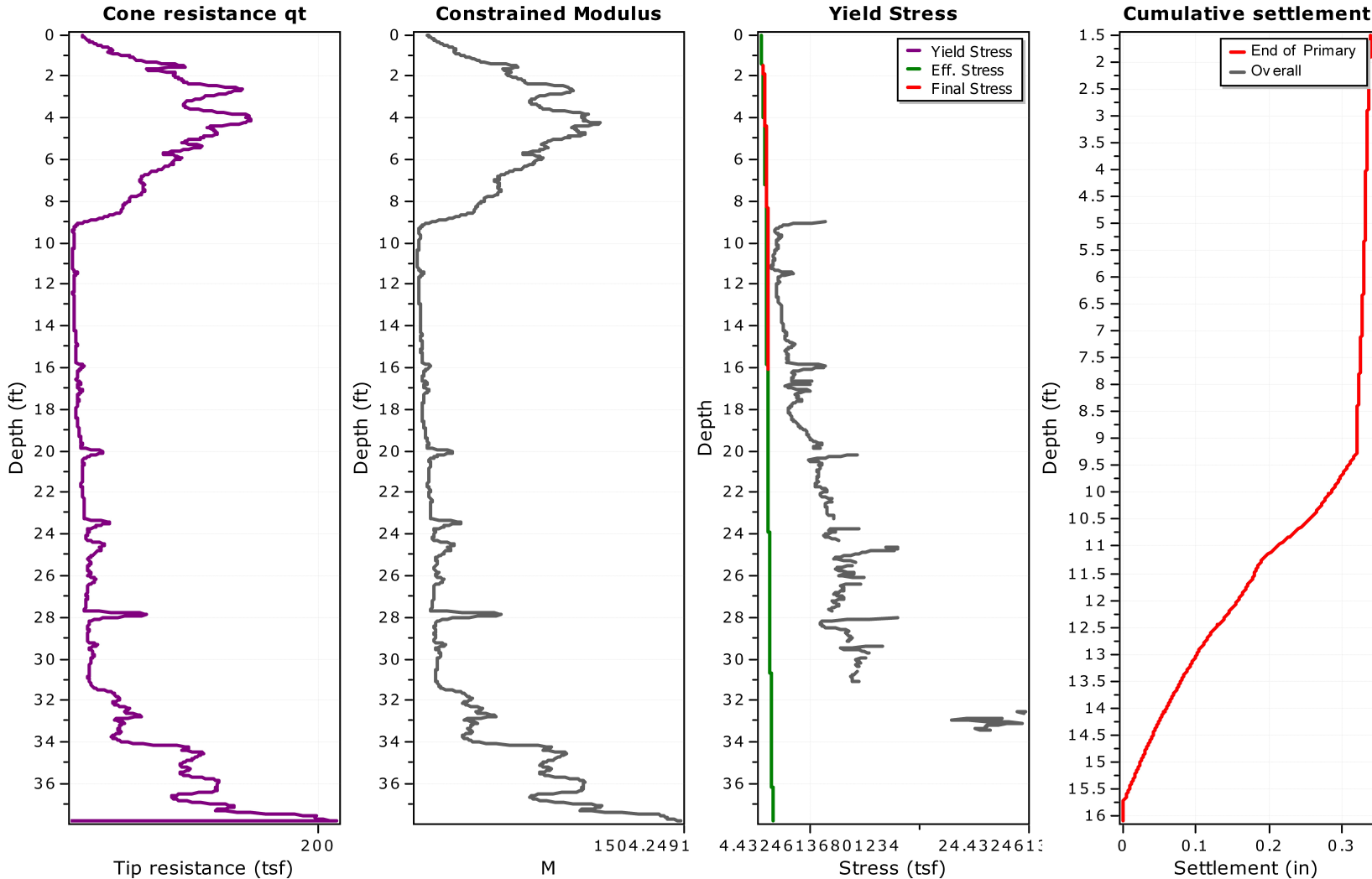
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**Settlements calculation according to theory of elasticity\***



**Calculation properties**

- Footing type: Rectangular
- Footing width: 40.00 (ft)
- L/B: 1.0
- Footing pressure: 0.13 (tsf)
- Embedment depth: 1.50 (ft)
- Footing is rigid: No
- Remove excavation load: No
- Apply 20% rule: Yes
- Calculate secondary settlements: No
- Time period for primary consolidation: N/A
- Time period for second. settlements: N/A

\* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlement calculation is performed according to the following formula:

$$S_c = S_p \left( 1 - e^{-\frac{t}{t_p}} \right)$$

where  $t_p$  is the duration of primary consolidation

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

**:: Unit Weight,  $g$  (kN/m<sup>3</sup>) ::**

$$g = g_w \cdot \left( 0.27 \cdot \log(R_f) + 0.36 \cdot \log\left(\frac{q_t}{p_a}\right) + 1.236 \right)$$

where  $g_w$  = water unit weight

**:: Permeability,  $k$  (m/s) ::**

$$I_c < 3.27 \text{ and } I_c > 1.00 \text{ then } k = 10^{0.952-3.04 \cdot I_c}$$

$$I_c \leq 4.00 \text{ and } I_c > 3.27 \text{ then } k = 10^{-4.52-1.37 \cdot I_c}$$

**::  $N_{\text{SPT}}$  (blows per 30 cm) ::**

$$N_{60} = \left( \frac{q_c}{p_a} \right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

**:: Young's Modulus,  $E_s$  (MPa) ::**

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to  $I_c < I_{c\_cutoff}$ )

**:: Relative Density,  $Dr$  (%) ::**

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}} \quad \text{(applicable only to SBT}_n\text{: 5, 6, 7 and 8 or } I_c < I_{c\_cutoff}\text{)}$$

**:: State Parameter,  $\psi$  ::**

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

**:: Drained Friction Angle,  $\phi$  (°) ::**

$$\phi = 29.5^\circ \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable only to SBT<sub>n</sub>: 5, 6, 7 and 8 or  $I_c < I_{c\_cutoff}$ )

**:: 1-D constrained modulus,  $M$  (MPa) ::**

If  $I_c > 2.20$   
 $\alpha = 14$  for  $Q_{tn} > 14$   
 $\alpha = Q_{tn}$  for  $Q_{tn} \leq 14$   
 $M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If  $I_c \geq 2.20$

**:: Small strain shear Modulus,  $G_0$  (MPa) ::**

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

**:: Shear Wave Velocity,  $V_s$  (m/s) ::**

$$V_s = \left( \frac{G_0}{\rho} \right)^{0.50}$$

**:: Undrained peak shear strength,  $S_u$  (kPa) ::**

$$N_{kt} = 10.50 + 7 \cdot \log(F_r) \text{ or user defined}$$

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

**:: Remolded undrained shear strength,  $S_u(\text{rem})$  (kPa) ::**

$$S_{u(\text{rem})} = f_s \quad \text{(applicable only to SBT}_n\text{: 1, 2, 3, 4 and 9 or } I_c > I_{c\_cutoff}\text{)}$$

**:: Overconsolidation Ratio, OCR ::**

$$k_{OCR} = \left[ \frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 + 7 \cdot \log(F_r))} \right]^{1.25} \text{ or user defined}$$

$$OCR = k_{OCR} \cdot Q_{tn}$$

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

**:: In situ Stress Ratio,  $K_0$  ::**

$$K_0 = (1 - \sin \phi') \cdot OCR^{\sin \phi'}$$

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

**:: Soil Sensitivity,  $S_t$  ::**

$$S_t = \frac{N_s}{F_r}$$

(applicable only to SBT<sub>n</sub>: 1, 2, 3, 4 and 9 or  $I_c > I_{c\_cutoff}$ )

**:: Peak Friction Angle,  $\phi'$  (°) ::**

$$\phi' = 29.5^\circ \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for  $0.10 < B_q < 1.00$ )

**References**

- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5<sup>th</sup> Edition, November 2012
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)
- N Barounis, J Philpot, Estimation of in-situ water content, void ratio, dry unit weight and porosity using CPT for saturated sands, Proc. 20th NZGS Geotechnical Symposium

## Appendix E. GBA Publication

# Important Information about This

# Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

**The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.**

## **Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects**

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

## **Read this Report in Full**

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

## **You Need to Inform Your Geotechnical Engineer about Change**

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

## **This Report May Not Be Reliable**

*Do not rely on this report* if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be, and, in general, if you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying it.* A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

## **Most of the "Findings" Related in This Report Are Professional Opinions**

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

## This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

## This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

## Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may

perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

## Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old*.

## Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration*. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists*.



Telephone: 301/565-2733

e-mail: [info@geoprofessional.org](mailto:info@geoprofessional.org) [www.geoprofessional.org](http://www.geoprofessional.org)

**Anchorage, AK  
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